

# TECHNICAL SPECIFICATIONS FOR PUBLIC IMPROVEMENT PROJECTS

CITY OF GARDNER, KANSAS

MAY 2007

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## GENERAL PROVISIONS

The provisions in this section shall be considered as applicable to all parts of these specifications including all revisions or supplements.

GP01 DEFINITIONS. Whenever the following words, phrases, or abbreviations appear in these specifications, they shall have the following meanings:

1. *City* shall mean the city of Gardner, Kansas, a municipal corporation, acting by and through its duly elected governing body and its duly appointed officials.
2. *Engineer* shall mean the City Engineer of the city of Gardner or his authorized representatives acting on behalf of the city.
3. *Design Engineer* shall mean a licensed engineer under contract to the developer or the city of Gardner for the purpose of preparing and sealing engineering design drawings for a specific public improvement project.
4. *Inspector* shall mean an authorized representative of the City Engineer who has been assigned to assure conformance to the requirements of these specifications by the contractor.
5. *Contractor* shall mean a person, partnership, or corporation duly licensed and bonded to the city of Gardner performing construction operations within the city of Gardner.
6. *Bond* shall mean performance and maintenance bonds and other instruments of security furnished by the contractor and his surety in accordance with these specifications.
7. *Day* shall mean a calendar day of twenty-four (24) hours measured from midnight to the next midnight.
8. Whenever the words *as directed*, *as required*, *as permitted*, or words of like meaning are utilized it shall be understood that the directions, requirements, or permission of the engineer is intended. Similarly, the words *approved*, *acceptable*, and *satisfactory* shall refer to approval of the engineer.

GP02 REFERENCED STANDARDS. Whenever references are made to standard specifications, methods of testing, materials codes, practices, and requirements it shall be understood that the latest revision of said references shall govern unless a specific revision is stated. Wherever any of the following abbreviations appear they shall have the following meaning:

AASHTO American Association of State Highway and Transportation Officials

ACI American Concrete Institute

AISC American Institute of Steel Construction, Inc.

ASA American Standards Association

ISO Insurance Services Office

ASTM American Society for Testing and Materials

AWWA American Water Works Association

ANSI American National Standards Institute, Inc.

KHS Standard Specification for State Road and Bridge Construction, Kansas Department of Transportation, latest edition.

Where the words *these specifications* appear or where words of similar connotation are used it shall be understood that such reference refers to the Technical Specifications and Design Criteria for Public Improvement Projects of the city of Gardner.

GP03 PERMIT FOR CONSTRUCTION. No construction of any private street or public improvement project shall be undertaken until the following criteria and requirements have been fully met.

1. Contract plans and specifications have been submitted to and approved by the city engineer.
2. A suitable performance and maintenance bond has been submitted and approved by the engineer and placed on file with the city.
3. A contract for city inspection, executed by the developer, and a copy of the bid proposal for construction has been submitted to and approved by the city engineer.
4. Five (5) working days advance notification from the contractor prior to actual start of work must be received by the city engineer.

Compliance with the above shall constitute a permit for construction activities. Work discovered underway not complying to these requirements shall be ordered to cease and shall not be allowed to commence until such requirements have been met.

GP04 AUTHORITY OF THE ENGINEER. The city engineer is designated by the city of Gardner to exercise all authority on behalf of the city to ascertain that all construction of facilities is equal to or better than the minimum construction requirements set forth in these specifications. The engineer shall be represented by a project inspector to check any and all work performed, including all materials to be incorporated in the work, and all construction methods and practices. The engineer shall have the sole authority to issue, in writing, any deviations from the provisions of these specifications or changes to any previously approved drawing.

GP05 OBSERVATION OF THE WORK.

1. General:

- A. All materials and workmanship shall be subject to observation, examination, or test by the city of Gardner and the engineer or his representative at any and all times during construction and at any and all places where such construction is carried on. The city of Gardner shall have the authority to reject defective material and workmanship or require its correction. Unacceptable workmanship shall be satisfactorily corrected. Rejected material shall be promptly segregated and removed from the project area and replaced with material of the specified quality to the satisfaction of the engineer. If the contractor fails to proceed at once with correction of rejected workmanship or defective material, the city of Gardner may contract or otherwise have the defects remedied or rejected materials removed from the project area and charge the cost of the same against the contractor, without prejudice to any other rights or remedies of the city of Gardner.
- B. The contractor shall have available on the work site at all times one copy of the approved plans and these technical specifications. He shall give the work the constant attention necessary to facilitate the progress thereof and shall cooperate with the city engineer, city inspectors, and other contractors in every way possible. The contractor shall designate and have on the work site at all times, as his agent, a competent superintendent capable of reading and thoroughly understanding the plans and specifications, who shall receive instructions from the engineer or his authorized representatives. The superintendent shall have full authority to execute the orders or directions of the engineer without delay and to supply promptly such materials, tools, plant equipment, and labor as may be required. Such superintendent shall be furnished irrespective of the amount of work sublet.
- C. The contractor shall at all times employ sufficient labor and equipment for prosecuting the several classes of work to full completion in the manner and time, as applicable, required by these specifications.

All workmen shall have sufficient skill and experience to perform properly the work assigned to them. Workmen engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to perform all work properly and satisfactorily.

Any person employed by the contractor or by any subcontractor who, in the opinion of the engineer, does not perform his work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the engineer, be removed forthwith by the contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the engineer.

Should the contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the engineer may suspend the work by written notice until such order(s) is/are complied with.

- D. The contractor shall furnish promptly all materials reasonably necessary for any tests which may be required. All tests by the city of Gardner will be performed in such manner as not to delay the work unnecessarily and will be made in accordance with the provisions of the Technical Specifications.
- E. The contractor shall notify the city of Gardner sufficiently in advance of backfilling or concealing any facilities to permit proper observation. If any facilities are concealed without approval or consent of the city of Gardner, the contractor shall uncover for observation and recover such facilities all at his own expense, when so requested by the city of Gardner.
- F. Neither observing, testing, approval nor acceptance of the work in whole or in part, by the city of Gardner or its agents shall relieve the contractor or his sureties of full responsibility for materials furnished or work performed not in strict accordance with the specifications.
- G. Any change or deviation from the approved plans and specifications that has been approved by the engineer must be received by the inspector in writing prior to implementing the change. The inspectors are not authorized to alter any provisions or to issue instructions contrary to these specifications, or to make any revisions to any previously approved drawing.

2. Defective Work:

- A. The term "defective" is used in these documents to describe work that is unsatisfactory, faulty, not in conformance with the requirements of the specifications, or not meeting the requirements of any observation, test, approval, or acceptance required by law or the specifications.
- B. Any defective work may be disapproved or rejected by the city at any time before final acceptance even though it may have been overlooked and included in a previous pay estimate.

- C. Contractor shall furnish samples of questionable equipment or materials from completed work for testing purposes when required by the engineer. All costs in connection with the testing of equipment and materials proven to be defective shall be paid by the contractor.

3. Uncovering Work:

- A. If any work is covered without concurrence of the inspector it must, if requested by the inspector, be uncovered for his observation. Such work will be at the contractor's expense unless the contractor has given the inspector timely notice and the inspector has not acted within a reasonable time.
- B. Should it be considered necessary or advisable by the city of Gardner, at any time before final acceptance of the entire work to make an examination of work already completed by uncovering the same, the contractor shall on request promptly furnish all necessary facilities, labor, and material. If such work is found to be defective in any important or essential respect, the contractor shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of the specifications, the actual cost of labor and materials necessarily involved in the examination and replacement, plus 15 percent of such cost to cover superintending, general expenses and profit, shall be allowed the contractor and he shall, in addition, if completion of the work of the entire contract has been delayed thereby, be granted a suitable extension of time on account of the additional work involved.

GP06 HOURS OF WORK, WEEKEND OR HOLIDAY WORK. Work on Saturdays or legal holidays shall be as approved by the city engineer. Requests for permission to work on legal holidays shall be considered upon advance notification of a minimum of two (2) working days prior to the anticipated date of the work to be performed. Sunday work shall not be permitted under any circumstance. The use of artificial light to permit night work shall not be permitted except in emergency situations.

Work will not be permitted prior to 7:00 a.m. and all work shall be completed prior to 7:00 p.m. The only exception to this is that no work will be permitted after sunset or before sunrise. Additionally, no paving operations will be permitted to start after 3:00 p.m. which cannot be completed by 5:00 p.m. Requests for permission to work overtime (beyond 5:00) shall be made directly to the attending project inspector by 12:00 noon that day. **Requests for permission to work on Saturdays shall be received no later than 3:00 p.m. the Thursday prior to the Saturday in question.**

Legal holidays observed by the city of Gardner are New Year's Day, **Martin Luther Kings' Day**, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day including the following Friday, Christmas, and the day after Christmas. The actual days off for these holidays may vary and in certain situations additional days may be a part of the amount of time granted as an official holiday by the city of Gardner. It shall be the contractor's responsibility to obtain these days prior to the actual request for inspection services.

GP07 BONDS. Suitable performance and maintenance bonds shall be furnished to the city of Gardner guaranteeing the proper completion and maintenance of the construction involved in the public improvement project. The performance bond shall be in an amount equivalent to the full cost of the improvement. The maintenance bond shall remain in effect for a period of two (2) years from the date of issuance of the Project Completion Certificate for all public improvement projects and shall be in an amount of the full cost of the improvement.

No project shall be accepted by the city prior to the submittal and acceptance of the maintenance bond by the city engineer.

GP08 CHANGES IN THE WORK. Changes in the work from the approved project plans shall be made only upon the written consent of the city engineer. All proposed changes must be submitted to the city engineer (by the design engineer) to receive written approval by the city. Said written approval shall be received by the inspector prior to implementing the deviation. Any change in the work made without the consent of the city engineer shall be subject to removal by the contractor at his expense.

GP09 TRAFFIC CONTROL. The flow of traffic in streets and access to private property shall be reasonably maintained at all times. The contractor shall provide a safe roadway, and shall erect and maintain warning signs, barricades and sufficient safeguards around all excavations, embankments, and obstructions. The contractor shall provide suitable warning lights or flares and shall keep them lighted from one-half hour prior to sunset until one-half hour after sunrise and all other times when visibility is limited. The contractor shall further provide such flagmen and watchmen as required by the engineer or inspector for the protection of the public. The design, placement and maintenance of traffic control devices shall correlate with and conform to the most recent edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The roadway shall be properly maintained and the contractor shall coordinate his operations with the city engineer in order that suitable arrangements may be made for detours, parking, access to private property, etc. Whenever a street is closed or partially closed, the city of Gardner Public Safety Department shall be notified of the closing, and also when normal service is resumed. In the event it is determined that the contractor is not maintaining a safe roadway, the engineer may improve the roadway conditions at the contractor's expense. All street closures or partial closures require prior approval by the City Engineer.

GP10 DAMAGES. The contractor hereby expressly binds himself or itself to indemnify and save harmless the city and its officers and employees against all suits or actions of every kind and nature brought or which may be brought, or sustained by any person, firm, or corporation, or persons, firms or corporations, in connection with or on account of the contractor's work or in consequence of any negligence in connection with same, or an account of any poor workmanship, or on account of any act of commission or omission of the contractor or his, its, or their agent or employees, or for any cause arising during the course of construction.

GP11 CLEANING UP. The contractor shall frequently clean up all refuse, rubbish, scrap materials, and debris as a result of his operations, so that at all times the site of the work shall present a neat, orderly, and workmanlike appearance. Upon completion of the work, the contractor shall remove from the site and any occupied adjoining property, all plants, buildings, rubbish, unused materials, form lumber, and other materials belonging to him or his subcontractor. Any costs incurred by the city due to failure by the contractor to clean up to the city's satisfaction will be charged to the account of the contractor or his surety.

GP12 PROTESTS. If the contractor considers any work demanded of him by the inspector to be outside the requirements of the specifications, he shall immediately ask for a written decision or instructions and shall proceed to perform the work to conform with the inspector's ruling. If the contractor considers such instructions unsatisfactory, he shall, within twenty-four (24) hours after their receipt, file a written protest with the engineer, stating his objections and the reasons therefore. Unless protests or objections are made in the manner specified and within the time limit stated herein, the contractor hereby waives all grounds for protest.

GP13 ACCEPTANCE OF WORK.

1. Partial Acceptance. The city reserves the right to accept and make use of any completed section of the work without obligating the city to accept the remainder of the work or any portion thereof; however, the warranty period shall start when the project is complete and the city has issued the Project Completion Certificate.
2. Final Acceptance. When the final clean-up has been performed, the contractor shall notify the inspector in writing that all work has been completed. At the same time, the contractor shall notify the design engineer that the project has been completed and should forward to the engineer all changes he has noted on his plans during the course of the work. Upon receiving such notification, the design engineer shall compute any changes in the original contract amount and send a letter to the city verifying the final contract amount. Within a reasonable time the inspector shall perform all necessary inspection procedures on the completed work. The contractor shall receive written notification of any defects in the project. The Project Completion Certificate will be issued after all defects have been corrected and all fees for inspection services have been paid.

The city will re-inspect the project prior to the expiration of the two-year maintenance bond. Any defects noted as a result of this inspection shall be corrected by the contractor at his expense upon written notification by the city.

GP14 SHOP DRAWINGS AND ENGINEERING DATA.

Engineering data covering all equipment and fabricated materials which will become a permanent part of the work shall be submitted to the Public Works Department for review. This data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

All submittals, regardless of origin, shall be stamped with the approval of the contractor and identified with the city project number, contractor's name, and references to applicable specification paragraphs and drawings. Each submittal shall indicate the intended use of the item in the work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

The contractor's stamp of approval is a representation to the city engineer that the contractor accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that he has reviewed or coordinated each submittal with the requirements of the work.

Each submittal shall include a statement prepared by the originator of the drawings and data certifying compliance with the City technical specifications except for deviations which are specifically identified.

All deviations from the City technical specifications shall be identified on each submittal and shall be tabulated in the contractor's letter of transmittal. Such submittals shall, as pertinent to the deviations, indicate essential details of all changes proposed by the contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

The contractor shall accept full responsibility for the completeness of each submission, and, in the case of re-submission, shall verify that all exceptions previously noted by the city engineer have been taken into account. In the event that more than one re-submission is required because of failure of the contractor to account for exceptions previously noted, the contractor may be required to reimburse the engineer for the charges of the engineer for review of the additional re-submissions.

Any need for more than one re-submission, or any other delay in obtaining the city engineer's review of submittals, will not entitle the contractor to extension of the contract time unless delay of the work is directly caused by a change in the work authorized by a Change Order or by failure of Engineering to return any submittal within twenty-one (21) days after its receipt in the city engineer's office.

The city engineer's review of drawings and data submitted by the contractor will cover along general conformity to the drawings and specifications, external connections, and dimensions which affect the layout. The city engineer's review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. The city engineer's review of submittals shall not relieve the contractor from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the city technical specifications.

Three (3) copies (or one reproducible copy) of each drawing and necessary data shall be submitted to the city engineer. The engineer will not accept submittals from anyone but the contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades. Re-submittals shall bear the number of the first submittal followed by a letter (A, B, etc.) to indicate the sequence of the re-submittal.

When the drawings and data are returned marked *NOT ACCEPTABLE* or *RETURNED FOR CORRECTION*, the corrections shall be made as noted thereon and as instructed by the city engineer and three (3) corrected copies (or one corrected reproducible copy) resubmitted.

When corrected copies are resubmitted, the contractor shall, in writing, direct specific attention to all revisions and shall list separately any revisions made other than those called for by the city engineer on previous submissions.

When the drawings and data are returned marked *EXCEPTIONS NOTED*, *NO EXCEPTIONS NOTED*, or *RECORD COPY*, no additional copies need be furnished. Distribution of acceptable submissions shall be as follows: two (2) copies to the city and one (1) copy to the contractor.

## SECTION 1000 - SITE PREPARATION

1001 SCOPE. This section covers the necessary clearing, grubbing, demolition, and other appurtenant work at the locations shown on the contract drawings.

1002 DEFINITIONS.

- a. Clearing. Clearing shall consist of the removal of all vegetable matter, such as trees, brush, down timber, rotten wood, sod, rubbish, and other objectionable combustible materials found on or above the surface of the site. It shall include the removal of wood buildings, fences, lumber, waste dumps, abandoned utilities, and trash, the salvaging of such materials as may be specified, and the disposal of the debris.
- b. Grubbing. Grubbing shall consist of the removal of all stumps, roots, buried trees and brush, and other objectionable combustible materials appearing on or below the surface of the ground which has not been included under the definition of "*Clearing*" above.
- c. Demolition. Demolition shall consist of the destruction and removal or incorporation into embankment all non-vegetable matter appearing above, on, or below the ground surface. This shall include, but not be limited to, all material derived from the demolition of portland cement concrete items such as base courses, curbs, curb and gutters, sidewalks, floors, steps, driveways, drainage structures of all sorts, guard fences, and other miscellaneous items such as foundations or walls of any sort, and iron or steel items, and asphaltic items such as pavement and base courses.
- d. Trees. Vegetable growth forty (40) inches or greater in circumference, measured two (2) feet above the ground shall be classified as a tree.
- e. Brush. Vegetable growth less than forty (40) inches in circumference, measured two (2) feet above the ground shall be classified as brush.

1003 UTILITY COORDINATION. The contractor shall be responsible for protecting any improvement of any agency, public or private, in the vicinity of clearing, grubbing or demolition operations. When necessary, the contractor shall enlist the assistance of the affected agencies in the location of their utilities. The contractor shall be responsible for the cost of all damage to such facilities arising from his carelessness or negligence.

1004 LIMITS OF CONSTRUCTION. The limits for clearing, grubbing, and demolition shall be as defined on the plans or specified in the Special Conditions but in no case shall work extend beyond the limits of the right-of-way, city property lines, or easements.

1005 PROGRESS OF CONSTRUCTION.

- a. Clearing. Clearing shall proceed well in advance of the construction operation so as not to delay the progress of the work. The refuse resulting from clearing may be hauled to a waste site secured by the contractor or shall be burned or buried in such a manner as to meet all laws, regulations, and requirements of any governing authority regarding health, safety, and public welfare. When authorized by the fire department, the contractor may dispose of such refuse by burning on the site of the project, provided all requirements as determined by Gardner Public Safety are met. Under no circumstances will the authorization to burn on the site relieve the contractor in any way from damages which may result from his operations. In no case shall any materials be left on the project site, shoved into abutting properties, or buried in embankments or trenches on the site.
- b. Grubbing. **Erosion control measures shall be in place prior to the start of grubbing operations.** Grubbing shall parallel the clearing as nearly as the sequence of operations will permit. Except for the special circumstances enumerated below, all stumps, roots, and other objectionable matter within the construction area shall be removed to a minimum depth of twelve (12) inches below the subgrade or the original ground, whichever is lower. All stumps, roots, and other objectionable matter outside the limits of the construction area but within the right-of-way shall be cut off flush with the ground.

All stumps, roots, and other objectionable matter within the specified limits of embankments having a depth of two (2) feet or less shall be removed and disposed of. Piling and butts of utility poles within the limits shall be removed to a minimum depth of two (2) feet below the subgrade or the original ground, whichever is lower.

All stumps, roots, and other objectionable matter found within borrow material to be used for embankment or fill material shall be removed.

All stumps, roots, and other objectionable matter found within the bottoms or sidewalls of excavation and trenching areas shall be completely removed from the respective bottom areas, and removed to a minimum depth of twelve (12) inches below the respective sidewalls.

- c. Demolition. Demolition work shall occur well in advance of the construction operation. Masonry and concrete walls, miscellaneous foundations, or other objects extending below ground shall be removed to a depth of at least twelve (12) inches below the original ground or the subgrade, whichever is lower.

When explosives are used in demolition, the contractor shall comply with the provisions of Specification Section 6100 *Blasting*.

In removing items such as portland cement concrete pavement, base courses, curbs, curb and gutters, gutters, sidewalks, and similar objects where portions of said objects are to be left in place, they shall be removed to an existing joint or to a new joint sawed to a minimum depth of one (1) inch with a true line and vertical face. Sufficient portions of these objects shall be removed to provide for the proper grade and connection to the new work.

1006 PROTECTION OF TREES AND SHRUBS. During construction operations, the contractor shall leave in place and protect from damage all trees, shrubbery, and flower beds unless shown on the drawings to be removed. Where trees existing on the project site are not to be removed, it shall be the responsibility of the contractor to trim low branches which would interfere with the normal operation of his equipment. The trimming shall be performed in a professional manner prior to any machine operation.

1007 CONSTRUCTION STAKING. The engineer shall, unless otherwise provided for, set construction stakes establishing lines, slopes, profile grades in roadway work, and center line and bench marks (hubs) for structure work and appurtenances as he may deem necessary and shall furnish the contractor with all necessary information relating to lines, slopes and grades. These stakes and marks shall constitute the field control by and in accordance with which the contractor shall establish other necessary controls and perform the work.

The contractor shall be responsible for giving the engineer reasonable notice of intent to perform work in a particular area of the project in order to afford the engineer sufficient time to set construction stakes establishing, lines, slopes and profile grades. For roadway work, the engineer will set construction stakes establishing, lines, slopes and profile grades and will furnish the contractor with all necessary information relating to these lines, slopes and grades. These stakes and marks will constitute the field control by and in accordance with which the contractor shall establish other necessary controls and perform the work. For structures, the engineer will stake and reference those center lines and layout lines used as dimensional references on the plans and provide a bench mark (hubs) at each structure location. The contractor shall be responsible for all other lines, locations, alignment, grade elevations and any other necessary control by use of engineering instruments or other tools or methods as required to build the structure.

**The contractor shall be responsible for the preservation of all stakes and marks, and if any construction stakes or marks are destroyed or disturbed, the cost of replacing them may be charged against the contractor and deducted from the payment for the work.**

## SECTION 1100 - GRADING

1101 SCOPE. This section covers the performance of all the work and appurtenances required for grading the project in coordination with all previous work performed at the locations shown on the contract drawings.

### 1102 MATERIALS AND DEFINITIONS.

- A. Grading. Grading shall be defined as meaning the performance of all excavation, embankment and backfill in connection with the construction of all improvements.
- B. Excavation. Excavation is defined as the removal of materials from the construction area to the lines and grades as shown on the contract drawings.

Unless otherwise provided for in the Special Conditions and included in the proposal, all excavation shall be unclassified excavation and the contractor shall satisfactorily remove and dispose of all materials encountered regardless of their nature.

When provided for in the Special Conditions and included in the proposal, the excavation may be classified according to the following categories.

- 1. Common Excavation. Suitable materials shall include all earth free of rock, sod, weeds, roots and other debris, and containing the soil characteristics and moisture content to obtain the required compaction.
  - 2. Rock Excavation. Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the engineer, requires drilling or blasting to remove the material.
- C. Embankment. Embankment is defined as the placing and compacting of material in the construction area to the lines and grades as shown on the contract drawings.

Material suitable for use as embankment shall be entirely imperishable and shall be determined as acceptable by the engineer.

Materials suitable for earth embankment shall be free of waste material, contain less than ten (10) percent by volume of rock and gravel, and contain no particles having a dimension greater than three (3) inches.

Materials suitable for rock embankment shall be free of waste material and contain ten (10) percent or greater by volume of rock or gravel containing particles ranging in size from a minimum dimension of three inches (3") to a maximum of twenty-four inches (24").

Material not suitable for use as embankment material shall include, but shall not be limited to, frozen material, organic material, topsoil, rubbish, rock, broken concrete, brick, asphaltic concrete, and other debris and soil not containing the characteristics and moisture content to obtain the required compaction.

D. Structures. Structures, as used herein, refers to bridges, basins, street drainage structures, headwalls, retaining walls, and similar construction.

1103 CONSTRUCTION - GENERAL. During excavation and embankment grading operations, the work shall be performed in a manner and sequence that will provide drainage at all times. Soft spots or areas that develop during grading operations shall be removed, the area then backfilled with suitable material and compacted to obtain the required density. No additional payment will be made to the contractor for this work.

1104 EXCAVATION - GRADING. Excavation of every character and of whatever materials encountered within the construction limits shall be performed to the lines and grades indicated on the contract drawings.

All suitable material removed by excavation shall be used as far as practicable in the formation of embankments or elsewhere when and as directed by the engineer. It shall be the responsibility of the contractor to handle excavation in any manner he sees fit, provided that suitable materials will be available when required. No additional compensation will be allowed for any special sequence of excavating or placing of such materials or any re-handling of materials.

Excavation materials in excess of the amount needed to complete the grading shall be considered as waste material which shall be removed from the site by and at the expense of the contractor.

Any additional fill material required which is not available from excavation within the construction limits shall be supplied by the contractor at no expense to the owner unless provided for in the proposal and Special Conditions. All such material brought to the site and incorporated in the work shall be subject to the approval of the engineer.

In the event during grading operations materials are encountered below grade or otherwise which are determined as being unsuitable or unstable by the engineer or his representative they shall be removed to the depth required to reach stable material. The area involved shall then be backfilled with suitable material as determined by the engineer and compacted to obtain the required density.

All roadway excavation in rock (shale, sandstone, limestone) shall be undercut no less than 12" for the full width of the roadway and backfilled with suitable soil or granular material. Undercut shall be unclassified excavation.

1105 EMBANKMENT--GRADING. The embankments shall be formed with suitable materials, as herein defined, procured from excavations made on the project site, or from borrow pits as required to complete the grading work.

Where embankments, regardless of height, are placed against hillsides or existing embankments, either of which have a slope steeper than one (1) vertical to six (6) horizontal, the existing slope shall be benched or stepped in approximately eighteen-inch (18") rises as the new fill is brought up in eight-inch (8") lifts. Benching shall be of sufficient width to permit operations of placing and compacting equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Materials thus cut out shall be recompacted to the required density along with the new embankment material. Material cut out, bladed into place, and compacted shall not be measured and paid for directly but will be considered as incidental work.

The existing surface upon which embankment material is to be placed shall have all unstable and unsuitable material, such as topsoil, peat, mulch, coal seams, disintegrated shale, rubbish, logs or stumps, and unconfined saturated soils, removed to the depths shown before starting the embankment work.

Where embankments two feet (2') or less in depth are to be placed on areas covered by existing pavement, the existing pavement shall be removed and the cleared ground surface shall be compacted at optimum moisture to the specified density. Where embankments greater than two (2) feet in depth are to be placed on areas covered by existing pavement, the existing pavement shall be broken into pieces not larger than twenty-four inches (24") maximum dimension, left in place and the embankment started thereon.

Earth embankment shall be placed in successive horizontal layers distributed uniformly over the full width of the embankment area. Each layer of material shall not exceed eight inches (8") in thickness (loose measurement) and shall be compacted to the density specified in paragraph 1106 before the next layer is placed thereon. As the compaction of each layer progresses, continuous blading will be required to level the surface and to ensure uniform compaction. Embankment construction shall not be performed when material contains frost, is frozen, or a blanket of snow prevents proper compaction.

Successive horizontal layers of rock embankment not exceeding two (2) feet in depth, shall be made by placing larger stones uniformly over the embankment area. Small stone fragments, sand, earth, or gravel shall be placed between the larger stones to fill all voids. Each layer shall be thoroughly compacted before the next layer is placed.

Large rocks shall be withheld from the top one foot or more of the embankment and only crushed stone or earth used in this layer. The crushed stone shall be well graded to form a dense mass when compacted and maintained adequate cohesive and interlocking characteristics.

1106 EMBANKMENT--BACKFILL AND COMPACTION. Each successive lift of backfill material shall be rolled with a tamping or sheepsfoot roller, except as provided below for sand and gravel, making a sufficient number of trips over the entire surface to compact all material thoroughly and uniformly. Compaction shall be continued until 95% of maximum density is obtained at the optimum moisture content as determined by ASTM D698.

Sand and gravel which cannot be compacted satisfactorily with a sheepsfoot roller shall be rolled with a pneumatic-tired roller. Each lift shall be rolled until no further consolidation is evident.

All the work involved in either adding moisture to, or removing moisture from embankment materials shall be considered incidental to the completion of the grading operation.

Backfilling behind curb or curb and gutter shall be done within seven (7) days after being laid unless otherwise approved by the engineer. All fill material placed behind the curb and gutter beneath and either side of sidewalks within the right-of-way shall be brought to 95% of maximum density at the optimum moisture content as determined by ASTM D698. The material used to fill the void behind curb or curb and gutter shall be free of rock and debris and shall be of a type that will leave no voids to pocket water and that will self-compact. Unless otherwise shown on the contract drawings, the finish grading from the back of the curb to the right-of-way line and/or utility easement line or construction easement line shall be performed to provide a smooth transition between existing yard grades at the right-of-way line and/or easement line to the curb so that positive drainage will exist.

The top portion of the backfill within right-of-way areas shall be finished with at least twelve (12) inches of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations.

Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two (2) inches to permit bonding of the topsoil to the underlying surface.

1107 STRUCTURE BACKFILL. Backfill around and outside of structures shall be deposited in layers not to exceed eight (8) inches in uncompacted thickness and brought to 95% of maximum density at optimum moisture content as determined by ASTM D698. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

Material for structure backfill shall be composed of earth only and shall contain no organic materials, broken concrete, stones, trash, or debris of any kind.

No tamped, rolled, or otherwise mechanically compacted backfill shall be deposited or compacted in water.

All backfill material shall consist of loose, earth having a moisture content such that maximum density of the compacted soil will be obtained. Moisture content shall be distributed uniformly and water for correction of moisture content shall be added sufficiently in advance that proper moisture distribution and compaction will be obtained.

Backfill around and outside of structures that will ultimately lie under proposed pavements shall be compacted to the requirements of Section 1205 "*Compaction Requirements*".

- 1108 SHEETING AND SHORING. Except where banks are cut back on a stable slope, excavation for structures shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances. Sheeting, bracing and shoring shall be considered subsidiary to excavation.
- 1109 FINAL GRADING. After other outside work has been finished, and backfilling and embankments completed and settled, all areas on the site of the work which are to be graded shall be brought to grade at the indicated elevations, slopes, and contours, including shoulder, berm, and sidewalk spaces. Use of graders or other power equipment will be permitted for final grading and dressing of slopes, provided the result is uniform and conforming to the lines and grades shown on the plans. The contractor shall repair any damaged surface and shall not use any equipment that will leave a marred surface.
- 1110 CLEANUP. Cleanup shall follow the work progressively and final cleanup shall follow immediately behind the finishing. The contractor shall remove from the site of the work all equipment, tools, and discarded materials, and other construction items. The entire right-of-way or easement shall be left in a finished and neat condition. Cleanup shall be considered a subsidiary obligation of the grading work.

In the event the contractor does not promptly comply with the terms of such instructions, the city may have the defective work corrected or the rejected work removed and replaced and all direct and indirect costs of such removal and replacement, including compensation for additional professional services, shall be paid by the contractor. The contractor will also bear the expenses of repairing work of others destroyed or damaged by his correction, removal or replacement of defective work.

- 1111 SETTLEMENT. The contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within two years after final completion of the contract under which the work was performed.

The contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the engineer.

- 1112 TEMPORARY SURFACING. If during construction activities it is deemed necessary to provide ingress and egress to the public by placement of temporary surfacing, the contractor shall do so at the direction of the city engineer or his authorized representative. Temporary surfacing shall meet the requirements of the Kansas Department of Transportation classification CA-5, for aggregates. Larger aggregates (3/4" or 1") may be used if, in the opinion of the city engineer additional stabilization is necessary. Temporary surfacing shall be supplied by the contractor at no expense to the owner unless provided for in the proposal and Special Conditions.

## SECTION 1200 - SUBGRADE PREPARATION

1201 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials, and the performance of all work connected with subgrade preparation, prior to constructing pavements for streets, alleys, parking areas, sidewalks, drive approaches and the construction of concrete curb and curb and gutters. This section does not include the construction of any base courses.

### 1202 DEFINITIONS.

- A. Subgrade. Subgrade is defined as a well-graded and compacted surface, constructed as specified herein to the grades, lines, and cross-section shown, bladed and compacted to the specified density, preparatory to constructing pavements, or other improvements thereon.
- B. Subgrade Preparation. Subgrade preparation is the repeated operation of fine grading and compacting the subgrade until the specified lines, grades, and cross-sections have been obtained and the materials are compacted to the specified depth and density.

### 1203 CONSTRUCTION REQUIREMENTS.

- A. General. All underground work contemplated, including clearing, grubbing, and demolition, shall be completed in accordance with the requirements of Section 1100 *Grading* prior to commencement of any subgrade preparation.

Prior to beginning any work on street subgrade the contractor shall secure the services of a qualified testing agency to acquire samples of the material to be used for subgrade construction. These samples shall be analyzed to determine proctor values, liquid limits, and plasticity index. Copies of the analysis shall be provided to the City Engineer for review prior to commencing any subgrade preparation. If it is determined that fly ash modification is required the following guidelines shall be followed.

The contractors testing agency shall determine the areas to be modified, the amount of fly ash to be used (% by weight), and the depth to be tilled.

Construction of pavements on high plasticity soils shall be modified with class "C" fly ash, or replaced with lower plasticity soils. High plasticity soils shall be defined as soils with a liquid limit greater than 50 and a plasticity index greater than 30. (See section #1208)

The subgrade surface shall be brought to the specified lines, grades and cross-sections by repeatedly adding or removing material and compacting to the specified density with a suitable roller to perform these operations.

- B. Foundation Treatment. Unless otherwise specified or shown on the contract drawings, the soil below grade line in cut sections shall be scarified, broken up, adjusted to a moisture

content within the designated moisture range and compacted to the designated type of compaction.

When the depth of compaction in cut sections is shown to be more than nine inches (9") material shall be removed to within nine inches (9") of the lower limit of the compaction. The layer of material left in place shall be scarified, broken up, adjusted to a satisfactory moisture content and compacted to the designated type of compaction. This process shall be repeated until the cut section is compacted to the grade as shown on the contract drawings.

All roadway excavation in rock (shale, sandstone, limestone) shall be undercut no less than 12" for the full width of the roadway and backfilled with suitable soil or granular material. Undercut shall be unclassified excavation.

- C. **Moisture Control Requirements.** The moisture content of the soil at the time of compaction shall be as necessary to obtain the density as designated on the contract drawings unless it is determined by the engineer that the soil is unstable with that moisture content.

When the moisture content of the soil is not satisfactory to the engineer, water shall be added or the material aerated, whichever is needed to adjust the soil to the proper moisture content. In no case, shall water be added without the consent of the engineer.

- D. **Compaction Control Requirements.** Roadway embankment earth (fill) materials shall be placed in horizontal layers not exceeding eight inches (8") unless otherwise approved by the engineer and shall be compacted as specified in Section 1205 *Compaction Requirements* before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compaction. Water shall be added or removed on the approval of the engineer, in order to obtain the required density.

- 1204 **MOISTURE CONTENT REQUIREMENTS.** The moisture content of the soil at the time of compaction shall be uniform and shall be such that the soil can be compacted to the requirements of the type of compaction as designated on the contract drawings or as directed by the engineer.

If Type B compaction is specified with this moisture control, the content shall be sufficient to produce a uniform mixture of the soil and moisture. It will be determined by the engineer whether or not satisfactory compaction and moisture content is obtained.

- 1205 **COMPACTION REQUIREMENTS.**

- A. **Pavements.** The subgrade for pavements shall be compacted to a density of at least ninety-five percent (95%) of the maximum density for the material used for a depth of at least nine inches (9") below the finished subgrade elevation and within the tolerance of the moisture for the type of material at ninety-five percent (95%) of maximum density, as

determined by the standard proctor test (ASTM D698) for cohesive soils. Any further compacted layers shall be accomplished in the same manner as specified.

When Type B compaction is specified or shown on the contract drawings, the compacted density is to be such that the tamping or sheepsfoot roller, while rolling the layer or lift will walk out of the material and ride the top portion of the lift.

Subgrade compaction for curbs and pavements shall be accomplished by use of sheepsfoot rollers. The roller may be self-propelled or machine drawn. The sheepsfoot roller shall be fully loaded with liquid or solid ballast to produce adequate compactive energy to the tamping foot. The roller shall have a minimum drum diameter of 30" and a 6" minimum length of tamping feet.

Compaction of low plasticity or non-plastic, fine-grained material shall be considered adequate when additional passes of the roller do not bring the tamping feet closer to the surface of the lift, provided the entire weight of the roller is supported on the tamping feet and none by material directly in contact with the drum.

Construction of pavements on high plasticity soils shall be modified with hydrated lime or class "C" fly ash or replaced with lower plasticity soils. High plasticity soils shall be defined as soils with a liquid limit greater than 50 and a plasticity index greater than 30.

Sand and gravel which cannot be compacted satisfactorily with a sheepsfoot roller shall be rolled with a pneumatic-tired roller. Each lift shall be rolled until no further consolidation is evident.

- B. Sidewalks. The subgrade for sidewalk pavements shall be compacted to a density equivalent to the density of the immediately surrounding soil in areas not requiring fill. In areas where fill is required, the subgrade shall be compacted to ninety-five percent (95%) of the maximum dry density as determined by ASTM D698 for cohesive soils or to seventy percent (70%) relative density as determined by ASTM D2049 for non-cohesive soils.
- C. Drive Approaches and Concrete Curb & Gutter. The subgrade for drive approaches and concrete curb and gutter shall be compacted to the same requirements as stated above in part *a. Pavements*.

1206 PROTECTION AND MAINTENANCE OF SUBGRADE. The newly finished subgrade shall be repaired from action of the elements. Any settlement or washing that occurs prior to the acceptance of the work shall be repaired and the specific lines, grades, and cross-section re-established.

The contractor shall protect all pavements, curbs, curb and gutters, and sidewalks from his subgrade operation with an earth cushion, timber planking, or both where tractors, graders, rollers, or other equipment are required to pass, or turn around. All resulting damage shall be

repaired. Any damaged work which cannot be repaired to the satisfaction of the engineer, shall be replaced by the contractor at his own expense.

- 1207 COMPACTION TESTING AND PROOF ROLLING. The subgrade must successfully pass compaction testing by a nuclear density/moisture measuring device and proof rolling with a loaded tandem dump truck carrying a minimum load of 16 tons. If as a result of the testing/proof rolling, the city engineer determines that further compaction is required, the contractor shall revise his methods or procedures as necessary to obtain density and stability.

1208 FLY ASH SUBGRADE TREATMENT

GENERAL

The purpose of this specification is to secure a completed section of treated material which contains a uniform mixture of fly ash and pulverized material with no loose or segregated areas, has a uniform density and moisture content, and is well bound for its full depth. It shall be the responsibility of the contractor to regulate the sequence of his work, to process a sufficient quantity of material to provide full depth as shown on the Plans, to use the proper amounts of fly ash, to maintain the work, and to rework areas as necessary to meet the requirements.

- A. The contractor shall secure the services of a qualified testing agency to perform on site testing. A qualified field technician shall monitor placement, mixing, moisture content and in place density. Copies of the test results shall be provided to the City Engineer for review prior to pavement placement. All costs incurred through the use of the testing agency shall be borne by the contractor-developer.
- B. A sample of the fly ash intended for use on the project will be submitted to the testing laboratory for the purpose of developing a fly ash proctor. The fly ash supplier will submit certified laboratory analysis indicating that fly ash used on the project conforms to A.S.T.M. C618, Class C, except the supplementary optional physical requirements in table 4 will not apply and the minimum calcium oxide (CaO) content of the fly ash shall be 25%. Fly ash shall be sampled and tested in accordance with A.S.T.M. C311.

Fly ash furnished by the contractor shall comply with the requirements of A.S.T.M. C618 class C. The minimum calcium oxide (CaO) content of the fly ash shall be 25%. Fly ash shall be stored and handled in closed waterproof containers prior to distribution on a roadway or fill. Fly ash that has been partially caked or set shall not be used. A certification indicating compliance to these specifications shall be attached to or be part of the scale ticket for each load delivered. The certification shall be signed by the producer or his assigned representative.

## 1209 CONSTRUCTION REQUIREMENTS

### A. Preparation of Roadbed

The subgrade shall be trimmed as near as possible to finish subgrade elevations as shown on the plans. The contractor shall allow for potential swell of material to minimize waste during final trimming. This may require the subgrade to be trimmed to slightly below proposed finished grade depending on the soil characteristics.

### B. Equipment

The machinery, tools, and equipment necessary for proper execution of the work shall be on the project and approved by the Engineer prior to beginning of construction operations. Pulveration of existing subgrade and blending of the mixture shall be accomplished by use of a drum-rotary type tiller equipped with an adjustable water proportioning system. Initial compaction shall be achieved using a self-propelled sheepsfoot compactor having a minimum operating weight of twelve tons with a minimum centrifugal force of 24 tons. Rubber-tired or smooth-wheeled rollers shall be used for final compaction of the stabilized section. All machinery, tools and equipment used shall be maintained in satisfactory and workmanlike manner. Fly ash shall be stored and handled in closed weatherproof containers until immediately before distribution. Fly ash exposed to moisture prior to mixing with recycled material shall be discarded.

### C. Application

The fly ash shall be spread in an approved manner at the rate specified. Care shall be taken to prevent the fly ash from flowing off the area to be treated. The fly ash shall be distributed at a uniform rate in such a manner as to minimize the scattering of fly ash by wind. Fly ash shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing fly ash becomes objectionable to adjacent property owners or significantly reduces the amount of fly ash incorporated into the work.

### D. Moisture Control

The required moisture content will be established by the contractors testing agency based on laboratory tests on the materials and specific fly ash content to be used for the treatment. Water shall be introduced directly into the rotary mixing drum during the tilling procedure. Final moisture content of the mix, immediately prior to compaction shall be uniform and not exceed plus or minus three percentage points of the optimum moisture content of the mix. If the moisture content exceeds the specified limits, additional fly ash may be added to lower the moisture content

to the required limits. Lowering the moisture content by aeration following addition of fly ash will not be allowed. If the moisture contents are below the specified limits, additional water shall be added and uniformly blended with the mixture. Additional fly ash added to lower the moisture content shall be at the expense of the Contractor.

E. Mixing

The pulverized subgrade material and fly ash shall be thoroughly mixed and the mixing continued until a homogenous, friable mixture of pulverized subgrade material and flyash meeting the specified size requirements is obtained. The subgrade material shall be pulverized through use of the specified equipment. Depth of pulverization shall be as designated. The pulverized subgrade material and fly ash shall be mixed thoroughly until a uniform mixture is obtained. All clods shall be reduced in size by mixing until the pulverized subgrade material-fly ash mixture meets the following size requirement when tested.

Sieve Size	Percent Retained
1"	0
½"	50

F. Compaction

Compaction of the mixture shall begin immediately after mixing and confirmation that the moisture content is within the specified range. The specified compaction shall be obtained within 1 hour after the incorporation of the fly ash. The material shall be sprinkled as necessary to maintain the specified moisture content. Compaction of the mixture shall begin at the bottom and shall continue until the entire depth of mixture is uniformly compacted to the specified density.

All non-uniform (too-wet, too dry or insufficiently treated) areas which appear shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and recompacting.

The stabilized section shall be compacted to a minimum of 95% of the combined materials maximum dry density.

In addition to the requirements specified for density, the section shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section is completed, tests will be made by the testing agency field technician. If the material fails to meet the density requirements, the Engineer may require it be reworked as necessary to meet those requirements and/or require the Contractor to change his construction methods to obtain required density on the next section. Additional fly ash will be added to the areas that are reworked at no additional cost to the owner, and the amount required shall be determined by the testing agency field technician. Should the section, due to any reason or cause, lose the required stability,

density and finish before the surface is placed or the work is accepted, it shall be reprocessed, recompact and refinished at the sole expense of the Contractor. Reprocessing shall follow the same patterns as the initial stabilization including the addition of fly ash.

G. Finishing and Curing

Following the compaction of the stabilized section the treated section will be trimmed to the required lines and grade by means of equipment which is automatically controlled with regard to grade. The surface shall then be compacted with a smooth wheel or pneumatic tired roller.

The Engineer may waive the use of automatically controlled equipment on projects containing narrow or irregular dimensions where operation of the automated equipment is impractical. Finishing of these areas may be as set forth above or the surface will be lightly scarified during finishing operations and bladed to a uniform grade and cross section to eliminate and imprints left by the equipment.

After the fly ash treated section has been finished as specified herein, the surface shall be protected against rapid drying by either of the following curing methods.

1. Maintain in a thorough and continuously moist condition by sprinkling.
2. Apply an asphaltic prime coat.

H. Weather Limitations

Fly ash mixing operations shall not be performed when the subgrade is frozen or when the ambient air temperature is less than 35 degrees F. The Contractor shall be responsible for protection and quality of the fly ash modified subgrade mixture under any weather conditions.

At cooler temperatures additional passes may be required to reduce the nominal size of the soil agglomerates to less than 1". Multiple passes of rollers may also be required to achieve specified densities in cooler weather conditions.

I. Proofrolling

Proofrolling with a loaded tandem dump truck carrying a minimum load of 16 tons will be required before acceptance of finish subgrade. Subgrade failures will be repaired by incorporating additional fly-ash into the subgrade. The use of fly-ash trimmings to correct areas of failure will not be permitted.

## SECTION 1300 - ASPHALTIC CONCRETE PAVEMENT

1301 SCOPE. This section covers asphaltic concrete pavement for roadways and parking areas.

1302 GENERAL. Pavement shall be constructed to the lines, grades, dimensions, and details contained herein or as shown on the plans.

Except as modified herein, asphaltic concrete pavement shall conform to Division 600 of the latest edition of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation and shall be as follows:

Surface Course Mix.....BM-2  
Base Course Mix.....BM-2B

Alternate mix designs may be used only where approved by the city engineer.

Composition of Mix. Mix designation BM-2 or BM-2B shall be composed of a combination of aggregates and mineral filler supplements meeting the requirements of Table 5, Section 1103 of the referenced state specifications, providing the mix meets the following composition limits. Not more than twenty-five percent (25%) of the mineral filler shall be present in uncrushed aggregate. The remaining mineral filler shall be present in crushed aggregate or shall be obtained by adding mineral filler supplements. Not more than eight percent (8.0%) by weight of the total mix shall be volcanic ash.

When specified for use in the surface course, mix designation BM-2 shall contain a natural sand of such grading that the portion passing the No. 8 sieve and retained on the No. 200 sieve will not be less than fifteen percent (15%) of the total mix. For this purpose, only sand from an alluvial deposit shall be used.

Immediately prior to the addition of the asphalt, the combined aggregate shall meet the following grading and plasticity requirements:

	PERCENT	RETAINED
	MASTER GRADING	DESIGN JOB-MIX
SIEVE SIZE	LIMITS	TOLERANCES
1"	0	
3/4"*	<b>0-5</b>	
3/8"	<b>10-30</b>	<b>+6</b>
4	---	<b>+6</b>
8	42-72	<b>+6</b>
16	---	<b>+5</b>
30	64-88	<b>+5</b>
50	---	<b>+4</b>
100	---	<b>+4</b>
200 (Wash & Scr)	<b>90-97</b>	<b>+2</b>

Plastic Index                      Max. 6  
Moisture in Final Mix:        Max. **0.5%**

\*For base construction only. For surface courses, 100% shall pass the 3/4" sieve.

In addition, there shall not be less than three percent (3%) nor more than twenty-three percent (23%) material between any two of the following successive sieves:

Numbers 4, 8, 16, 30, and 50.

The asphalt content for each bituminous mix shall be the optimum content plus or minus one-half percent (1/2%) , as determined by the city engineer and shall be based on the Marshall Method test property curves for hot-mix design, to be submitted by the contractor a minimum of five days in advance of the paving operation.

Permissive Recycling. The contractor may use all new materials or a blend of new materials in combination with a maximum of 10% reclaimed asphalt pavement (RAP) in conformance with Section 1103.02(d) of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation.

1303 SUBGRADE PREPARATION. Subgrade preparation for pavement shall be as specified in Section 1200--*Subgrade Preparation*.

1304 TRANSPORTATION OF MIX. The mix shall be transported to the jobsite in vehicles cleaned of all foreign material which may affect the mix. The inside of the truck beds shall be lubricated with a thin oil to prevent the mix from adhering to the bed, but an excess of lubricant will not be permitted. Vehicles shall be provided with covers of sufficient size and weight to

protect the load and to prevent cooling of the mix during transportation to the site in cold weather when required by the engineer. The contractor shall provide a sufficient number of haul vehicles of the proper size, speed, and condition to ensure an orderly and continuous placement operation.

- 1305 PLACING REQUIREMENTS. The bituminous mixture shall be spread and finished reasonably true to crown and grade by a mechanical, self-propelled paving machine. Bituminous mixtures may be spread and finished by other methods only where machine methods are impractical as determined by the engineer.

All bituminous mixtures shall be delivered to the paver at a temperature between 250°F and 325°F. Delivery of the material to the paver shall be at a uniform rate and in an amount well within the capacity of the paving and compacting equipment. No asphaltic concrete shall be placed on frozen or wet subgrade.

The maximum depth of any individual lift shall be four inches (4"). A minimum of one leveling course shall be placed prior to placement of the surface course for asphaltic pavements which consist of a total depth of ten inches (10") or less. A minimum of two (2) leveling courses shall be placed for asphaltic pavements greater than 10 inches (10").

When bituminous materials are being applied, the surface of all structures, curb and gutters, and other roadway appurtenances shall be protected in a satisfactory manner to prevent them from being splattered with bituminous material or marred by equipment operation. In the event that any appurtenances become splattered or marred, the contractor shall, at his own expense, remove all traces of bituminous material and repair all damage, and leave the appurtenances in as good condition as they were before the work began.

All mixed material shall be delivered to the paver in time to permit completion of spreading, finishing, and compaction of the mixture during the daylight hours. **Night time work on projects will not be permitted unless approved by the City Engineer.**

Hot-mix asphalt paving shall be placed when the ambient temperature is 40°F and rising for base pavements and 50°F and rising for surface pavements. Hot-mix asphalt paving shall not be placed when there is frost in the subgrade or at any other time when weather conditions are unsuitable for the type of material being placed without the expressed consent of the engineer. When the ambient temperature falls below 55°F, precautions shall be taken to compact the mix before it cools too much to obtain the required density. In no case shall successive lifts of asphalt be placed until the previous lift has cooled to 150°F or less.

- 1306 MECHANICAL PAVING MACHINES. Mechanical pavers shall be capable of spreading the mix, within the specified tolerances, true to the line, grade, and crown indicated on the contract drawings.

Pavers shall be equipped with quick and efficient steering devices and shall be capable of traveling both forward and in reverse. They shall be equipped with hoppers and distributing

screws which place the mix evenly in front of adjustable screens. They shall be equipped with a vibrating screed.

The screed shall include any strike-off device operated by cutting, crowding, or other action which is effective on mixes at workable temperatures without tearing, shoving, or gouging them and which produces a finished surface of an even and uniform texture. The screed shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required.

Pavers shall be capable of spreading mixes without segregation or tearing. They shall also be capable of placing courses in thicknesses of from one-half (1/2) inch to at least three inches (3"), and from widths of eight feet (8') to at least thirteen feet (13'). Extensions and cut-off shoes shall permit changes in widths by increments of six inches (6"), or smaller.

- 1307 COMPACTION REQUIREMENTS. Rollers and other compactive devices shall be operated by competent and experienced roller personnel and shall be kept in operation continuously if necessary so that all parts of the pavement will receive substantially equal compaction. The engineer shall order the mixing plant to cease operations at any time proper rolling is not being performed.

After spreading and strike-off and as soon as the temperature and mix conditions permit the compacting to be performed without excessive shoving or tearing, the mixture shall be thoroughly and uniformly compacted.

Compacting equipment shall consist of both steel-wheeled and pneumatic-tired rollers and shall be on the site of the work prior to placement of the pavement. The compaction equipment shall be self-propelled and capable of smooth starting, stopping and reversing without backlash. Generally, the number and weight of rollers shall be sufficient to compact the pavement mixture to the required density while it is still in a workable condition.

Two-axle tandem steel rollers shall weigh not less than eight tons (8 tons) or more than twelve (12) tons. Three-axle tandem steel rollers shall not weigh less than twelve tons (12 tons). Three-wheeled steel rollers shall weigh not less than eight tons (8 tons) or more than twelve tons (12 tons). All rollers shall be equipped with water tanks and sprinkling devices which shall be used for wetting the rolls to prevent adherence of the placed material.

Light pneumatic-tired rollers shall be constructed to allow loading to provide a gross weight of at least two hundred and twenty-five pounds (225 lbs) per inch of tire tread. Heavy pneumatic-tired rollers shall be constructed to allow loading to provide a gross weight of not less than eight tons (8 tons) and not more than twelve tons (12 tons). The tires on the front and rear axles of all pneumatic-tired rollers shall have smooth treads and shall be staggered to provide complete coverage over the entire area over which the roller travels.

The selection of the type of roller to be utilized in breakdown rolling may be varied to suit mix characteristics and shall be acceptable to the engineer. The final rolling of the top or surface

course shall be accomplished with a steel roller unless otherwise approved by the engineer. In the event a vibratory roller is used for finish rolling, it shall be operated with the vibratory unit in its off position.

During rolling, the roller wheels shall be kept moist with only sufficient water to avoid picking up the material. The speed shall not exceed three miles per hour (3 mph) for steel-wheeled rollers and five miles per hour (5 mph) for pneumatic-tired rollers.

The line of rolling shall not be changed suddenly or the direction of rolling reversed suddenly. If rolling causes displacement of the material, the affected areas shall be loosened at once with lutes or shovels and restored to the original grade of the loose material before being re-rolled. Heavy equipment or rollers shall not be permitted to stand on the finished surface before it has been compacted and has thoroughly cooled.

In laying a surface mix adjacent to any finished area, it shall be placed sufficiently high so that, when compacted, the finished surface will be true and uniform.

Any mixture that becomes loose, broken, mixed with foreign material, or which is in any way defective in finish or density, or which does not comply in all other respects with the requirements set forth herein, shall be removed, replaced with suitable material, and finished by and at the expense of the contractor in accordance with these specifications.

- 1308 **BITUMINOUS TACK COAT.** Prior to the distribution of bituminous materials, the contractor shall remove all loose materials from the surface by means of approved mechanical sweepers or blowers and/or hand brooms until it is as free from dust as is practicable. Side roads to receive bituminous treatment shall be shaped and bladed at the same time the sub-base is cleaned.

Contact surfaces of curbing, gutters, manholes, and similar structures shall be coated with a thin uniform coating of asphaltic material. The bituminous mixture shall be so placed so that after compaction it will be one-fourth inch (1/4") above the edge of the contact surfaces of such structures.

Joints between old and new pavements or between successive days' work shall be made so as to ensure thorough and continuous bond between the old and new mixtures.

Prior to placing the new pavement against a cut joint or against old pavement, the contact surface shall be sprayed or painted with a thin uniform coat of asphalt material.

The tack coat shall be applied to the areas to be surfaced as soon as practicable after they have been prepared and are sufficiently dry at the rate of from 0.2 to 0.5 gallons/square yard at application temperature. Tack coat shall not be applied in the early morning nor in the late afternoon. Bituminous materials shall be applied by means of approved pressure distributors operated by skilled workmen.

The spray nozzles and spray bar shall be so adjusted and frequently checked that uniform distribution is ensured. The distribution shall cease immediately upon any clogging or interference of any nozzle and corrective measures taken before distribution is resumed. Hand sprays shall be used in tacking small patches or inaccessible areas that have been missed by the distributor.

The asphalt tack shall be entirely fogged over the base course and therefore require no sand blot. If, however, it has not been uniformly distributed, sufficient sand shall be spread over the surface to blot up the excess asphalt and prevent it from picking up. Prior to laying an intermediate or surface course, all loose or excess sand shall be swept from the base.

The contractor shall maintain the tack coat treatment and the surface of the sub-base intact until it has been covered by the surface course. Areas that have been damaged by traffic shall be repaired and shall receive applications of tack coat material in compliance with these specifications. The maintenance and repair of the tack coat shall be done at the contractor's expense.

- 1309 DENSITY AND SURFACE REQUIREMENT. The completed asphaltic concrete pavement shall have a density of greater than or equal to ninety-five percent (95%) of Standard established by the Marshall Density procedure, using a fifty blow method.

All unsatisfactory work shall be repaired, replaced, or corrected. The surface of the final course shall be of a uniform texture and conform to line and grade shown on the plans.

Both density and thickness shall be carefully controlled during construction and shall be in full compliance with plans and specifications. During compaction, preliminary tests, as an aid for controlling thickness shall be made by means approved by the engineer.

Upon request by the engineer, representative samples of the compacted asphalt paving shall be obtained by the contractor under the supervision of the engineer and shall be tested by a suitable independent or municipal testing laboratory as necessary to verify compliance with respective density requirements.

Selection of the independent testing laboratory, the number, timing, location and testing procedures for the representative samples shall be approved by the engineer. The testing laboratory shall submit to the engineer four (4) copies of each report covering the details and results of the tests. All costs for the testing laboratory and all other costs of testing shall be borne by the contractor, unless otherwise specified.

The surface of the final surface course shall not vary from a ten foot (10') straight edge, applied parallel to the centerline, by more than one-fourth inch (1/4").

- 1310 PROTECTION OF PAVEMENT. The contractor shall protect all sections of newly compacted base and surface courses from traffic until they have hardened properly, or as directed by the engineer.

1311 COMPACTION TESTING. At the option of the engineer, compaction testing may be performed in the field using a nuclear density-moisture measuring device to determine the density of the mixture as placed. If as a result of this field testing the engineer determines that further compaction is required, the contractor shall revise his rolling procedure to obtain the density as specified.

## SECTION 1400 - PORTLAND CEMENT CONCRETE PAVEMENT

1401 SCOPE. This section governs the furnishing of all labor, equipment, tools, and materials and the performance of all work necessary to construct portland cement concrete pavement.

1402 MATERIALS. Except as modified herein, all materials used for construction of portland cement concrete pavement shall conform to the requirements stipulated in applicable sections of this Technical Specification for Public Improvement Projects of the City of Gardner.

a. Concrete. The concrete for the use in construction of portland cement concrete pavement shall conform to the concrete specifications listed in Section 2000.

b. Reinforcing Steel.

Bars: Bars shall conform to ASTM A615, A616, and A617.

Welded Steel Wire Fabric: ASTM A185.

Supporting Elements: Representative samples of supporting elements shall be submitted and approved by the engineer prior to their use in the project.

c. Expansion Joint Fillers. Expansion joint fillers shall conform to ASTM D994, D1751 or D1752.

d. Joint Sealing Compound. Joint sealing compounds shall meet Federal Specification TT-S-1543 and have the following minimum properties:

Durometer, Shore A	15-25	ASTM D 2240
Tensile stress @ 150% Elongation, psi	45 max.	ASTM D 412 Die C
Elongation, %	1200 min	ASTM D 412

e. Curing Membrane. All material to be used or employed in curing portland cement concrete must be approved by the engineer prior to its use. It shall be of the liquid membrane type and shall conform to ASTM C309.

1403 CONSTRUCTION DETAILS. The portland cement concrete pavement shall be constructed to the configuration, and to the lines and grades shown on the plans.

- A. Grading and Subgrade Preparation. All excavation or embankment required shall be as defined in Sections 1100--*Grading* and 1200--*Subgrade Preparation* of these technical specifications.
- B. Forms. All forms shall be in good condition, clean, and free from imperfections. Each form shall not vary more than 1/4 inch in horizontal and vertical alignment for each 10 feet in length.
  - 1. Material & Size. Forms shall be made of metal and shall have a height equal to or greater than the prescribed edge thickness of the pavement slab.
  - 2. Strength. Forms shall be of such cross-section and strength, and so secured as to resist the pressure of the concrete when struck off, vibrated, and finished, and the impact and vibration of any equipment which they may support.
  - 3. Installation. Forms shall be set true to line and grade, supported through their length and, joined neatly in such a manner that the joints are free from movement in any direction.
  - 4. Preparation. Forms shall be cleaned and lubricated prior to each use and shall be so designed to permit their removal without damage to the new concrete.
  - 5. Paving Machine. A slip-form paving machine may be used in lieu of forms. The machine must be equipped with mechanical internal vibrators, and be capable of placing the portland cement concrete pavement to the correct cross-section, thickness, line and grade within the allowable tolerances.

1404 JOINTS. Generally joints shall be formed at right angles to the true alignment of the pavement and to the depths and configuration specified by the standard drawings or as modified by the plans and specifications.

- A. Expansion Joints. Expansion joints shall be placed at all locations where shown on the plans and standard details or as directed by the engineer.
  - 1. General. Expansion joints shall extend the entire width of the pavement and from the sub-grade to one inch below the surface of the pavement or the material will have a suitable tear strip provided to allow for the application of the joint sealer.

Under no circumstances shall any concrete be left across the expansion joint at any point.
  - 2. Material. Expansion joints shall be formed by a one piece, one inch thick preformed joint filler cut to the configuration of the correct pavement section.

3. Stability. Expansion joints shall be secured in such a manner that they will not be disturbed during the placement, consolidation and finishing of the concrete.
  4. Dowels. If expansion joints are to be equipped with dowels they shall be of the size and type specified, and shall be firmly supported in place by means of a dowel basket which shall be installed in such a position that the center line of the joint assembly is perpendicular to the center line of the slab and the dowels lie parallel to the slab surface and parallel the center line of the slab. One half of each dowel shall be painted in accordance with the directions shown on the Plans, and then thoroughly coated with hard grease, or an approved lubricant, to prevent the concrete from bonding to that portion of the dowel. As an option, a dowel sleeve of the dimensions shown on the plans or standard drawings may be used in lieu of grease.
- B. Contraction Joints. Contraction joints shall be of the type and dimensions and at the spacing shown on the plans or standard drawings.
1. Templates. The templates shall be removed as soon as the concrete has attained its initial set and finished as outlined for tooling joints.
  2. Sawing. Sawed contraction joints shall be cut by means of wet sawing with an approved concrete saw. The joints shall not be sawed until the concrete has hardened to the extent that tearing and ravelling is precluded.

All joints shall be sawed during the initial curing period and the sawing shall begin before the pavement starts shrinking and before uncontrolled cracking takes place.

Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or the removal of the curing media and the cutting of the joints. In no case shall the pavement be left overnight without having the joints sawed.

The standard contraction joint configuration is a **1/8"-3/16"** wide joint sawed to a depth of **1/3** the thickness of the slab. Material created by sawing shall be flushed from the pavement before it has had time to dry or set. The spacing shall be as shown on the plans but should generally not exceed 12 feet.

The joint shall be thoroughly cleaned by approved methods prior to the placing of the joint material. This is accomplished by sand-blasting the dry joint in two passes, one for each joint face. This sand, as well as dust and dirt deposited by wind and traffic, must be blown out of the joint and away from the area around it using a high-pressure air blast prior to placing the joint material.

3. Pre-molded Strip Joints. Pre-molded strip joints shall be of the proper dimensions as shown on the plans and standard drawings and shall be secured at the proper location so as not to be disturbed by the finishing of the concrete.

C. Longitudinal and Construction Joints. Longitudinal joints or construction joints shall be placed as shown on the plans or where the contractor's construction procedure may require them to be placed.

1. Center Joints. Longitudinal center joints shall be constructed using the methods specified in Section 1404b "Contraction Joints".
2. Longitudinal Construction Joints. Longitudinal construction joints (joints between construction lanes) shall be keyed joints or shall be constructed with tiebars. Joint configuration shall conform to the dimensions shown on the plans or standard drawings.
3. Transverse Construction Joints. Transverse construction joints of the type shown on the plans or standard drawings shall be placed wherever concrete placement is suspended for more than 30 minutes or for such a time that the concrete has begun to take its initial set. No construction joint shall be placed within ten (10) feet of an expansion, contraction, or other construction joint.
4. Tiebars. Tiebars shall be of deformed steel of the dimensions specified by the plans or standard drawings. Tiebars shall be supported in the proper position and at the specified spacing and be firmly secured so as not to be disturbed by the construction procedure. They shall be free from dirt, oil, paint, grease, loose mill scale, and thick rust which could impair bond of the steel with the concrete.

1405 PLACING, FINISHING, CURING, AND PROTECTION. Concrete shall be furnished in quantities required for immediate use and shall be placed in accordance with the requirements of Section 2000--*Concrete* of these technical specifications and as specified herein.

A. Concrete Placement. Prior to placement of the concrete pavement, all debris and foreign material shall be removed from the inner surfaces of the forms and all forms and subgrade properly moistened. All required reinforcement and other special metal parts shall be properly and firmly set into position to preclude movement during placement of the concrete.

The concrete shall be deposited over the entire width of the prepared subgrade between the forms in such a manner to prevent segregation and to require as little rehandling as possible. The pour shall be made to the required depth and width of the construction lane in successive batches and in a continuous operation without the use of intermediate forms or bulkheads. Concrete shall be thoroughly vibrated along the forms or sides and along expansion and key type longitudinal joints. Attachments on finishing machines to vibrate the concrete adjacent to forms and longitudinal joints will be permitted provided satisfactory results are attained. Care shall be taken that the vibrator does not penetrate the subgrade or dislodge or move the joints. The vibrating shall be sufficient to produce a smooth pavement edge. Over vibrating will not be permitted as it will cause segregation. Insufficient vibrating can cause honeycomb. Honeycomb in the edge may be cause for rejection of the pavement.

The concrete shall be well vibrated and tamped against the forms and along all joints. Care shall be taken in the distribution of the concrete to deposit a sufficient volume along the outside form lines so that the curb section can be consolidated and finished simultaneously with the slab.

No concrete shall be placed around manholes or other structures until they have been brought to the required grade, alignment, and cross slope. All utility appurtenances shall be boxed out and isolated using expansion joint material. The minimum size of a boxed out section shall be two feet by two feet.

Concrete shall not be allowed to extrude below the forms.

- B. Concrete Finishing. The pavement shall be struck off and consolidated with a mechanical finishing machine or by hand-finishing methods.

When a mechanical finishing machine is used, the concrete shall be struck off at such a height that after consolidation and final finishing it shall be at the exact elevations as shown on the plans. A depth of at least 2 inches of concrete shall be carried in front of the strike-off screed for the full width of the slab, whenever the screed is being used to strike off the pavement. The finishing machine shall be provided with a screed which will consolidate the concrete by pressure. The concrete shall, through the use of this machine, be brought to a true and even surface, free from rock pockets, with the least possible number of passes of the machine. The edge of the screeds along the curb line may be notched out to allow for sufficient concrete to form the integral curb. Hand-finishing tools shall be kept available for use in case the finishing machine breaks down.

When hand finishing is used, the pavement shall be struck off and consolidated by a vibrating screed to the exact elevation as shown on the plans. When the forward motion of the vibrating screed is stopped, the vibrator shall be shut off; it shall not be allowed to idle on the concrete. Internal mechanical vibration shall be used along all formed surfaces.

1. Longitudinal Floating. After the concrete has been struck off and consolidated, it shall be further smoothed by means of a mechanical longitudinal float or float finishers using a longitudinal hand float. If a longitudinal hand float is used, it shall be operated from foot bridges spanning the pavement and shall be worked with a wiping motion parallel to the centerline, and passing from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than 1/2 of the length of the float. The float shall not be less than 12 feet in length and 6 inches in width, and shall be properly stiffened and provided with handles at each end. This operation may be eliminated if specified tolerances can be attained by some other approved method.

In cases where the longitudinal floating operation has been eliminated, the pavement shall be scraped with a straight edge 10 feet long, equipped with a handle to permit it to be operated from the edge of the pavement. The longitudinal float and straightedge shall be operated so that any excess water and laitance are removed from the surface of the pavement. After the scraping operation, the surface of the pavement shall be within the specified tolerances.

2. Straightedging. While the concrete is still plastic, the slab surface shall be tested for smoothness with a 10-foot straightedge swung from handles 3 feet longer than one-half the width of the slab. The straightedge shall be placed on the surface parallel to the centerline of the pavement and at not more than 5 foot intervals transversely. After each test the straightedge shall be moved forward one-half its length and the operation repeated. When irregularities are discovered, they shall be corrected by adding or removing concrete. All disturbed places shall be smoothed with a float not less than 3 feet long and not less than 6 inches wide, and again straightedged. The pavement surface shall have no depression in which water will stand.
3. Edging. Before final finishing is completed and before the concrete has taken its initial set, the edges of the slab and curb shall be carefully finished with an edger of the radius shown on the plans or standard details.
4. Final Surface Finish. A burlap drag or a broom finish shall be used as the final finishing method. When a drag is used it shall be at least 3 feet in width and long enough to cover the entire pavement width. It shall be kept clean and saturated while in use. It shall be laid on the surface of the pavement and dragged in the direction in which the pavement is being laid. When broom finishing, a hard bristle broom shall be used. The broom shall be kept clean and used in such a manner as to provide a uniform textured surface. The curb shall have the same final finish as the pavement.

The final surface of the concrete pavement and curb shall have a uniform gritty texture free from excessive harshness and true to the grades and cross section shown on the plans. The engineer may require changes in the final finishing procedure as required to produce the desired final surface texture.

- C. Curing. Curing shall conform to the requirements set forth in Section 2000 - Concrete with the exception that water proof paper, or polyethylene sheeting, shall not be acceptable as curing methods for concrete pavement. The use of straw or burlap for curing shall be as approved by the engineer.

As soon as practical after the concrete is finished it shall be cured with one of the acceptable methods. If a liquid curing membrane is used, it shall be according to the manufacturer's directions.

A nozzle producing a uniform mist pattern will be used on all spray equipment when applying the liquid curing membrane. Rate of application to the pavement shall be (1 gallon/175 ft) with a wet thickness of 6 to 10 mils.

If the forms are removed from finished concrete pavement within a period of 72 hours or if a slip form paving machine has been used, these surfaces shall also be cured.

- D. Protection. The contractor shall, at his own expense, protect the concrete work against damage or defacement of any kind until it has been accepted by the city. Concrete pavement which is not acceptable to the engineer because of damage or defacement, shall be removed and replaced, or repaired to the satisfaction of the engineer, at the expense of the contractor.

All vehicular traffic shall be prohibited from using the new concrete pavement until it has attained the proper strength. The concrete pavement shall not be opened for light traffic until the concrete is at least 72 hours old and has attained a minimum compressive strength of 3000 pounds per square inch. The pavement shall not be opened to all types of traffic until the concrete is at least 120 hours old and has attained a minimum compressive strength of 3500 pounds per square inch. If high early strength concrete is used, the pavement may be opened to all types of traffic when the concrete has attained a compressive strength of 3500 pounds per square inch.

- E. Temperature Limitation. Concrete work shall proceed in accordance with the requirements established in Section 2000-*Concrete*.

- 1406 BACKFILL. A minimum of 24 hours shall lapse before forms are removed and 5 days shall lapse before pavement shall be backfilled unless otherwise approved by the engineer.

Backfill shall be accomplished in accordance with Sections 1100--*Grading* and 1200-*Subgrade Preparation*.

The contractor shall be responsible for the repair of any existing street pavement disturbed by the construction to the satisfaction of the engineer.

- 1407 JOINT SEALING AND CLEANUP. **All joints shall be sealed with an approved joint sealer applied in accordance with the manufacturer's directions and city specifications, standards and design criteria.** The joints shall be sealed within 7 days of the placement of the concrete and prior to the opening of the pavement to traffic.

The contractor shall be responsible for the removal of excess dirt, rock, broken concrete, concrete splatters and overspray from the area of the construction.

- 1408 CONCRETE CURB. Concrete curb will be constructed as shown on the plans unless otherwise approved by the city engineer. The three options available for concrete curb are as listed below and detailed in Standard Details 20-1 through 20-3.

- A. Integral curb Integral curb shall be constructed immediately following the finishing operation unless otherwise shown on the plans. Special care shall be taken so that the curb construction does not lag the pavement construction and form a "cold joint."

Steel curb forms shall be required to form the backs of all curbs except where impractical because of small radii street returns or other special sections.

In placing curb concrete, sufficient spading shall be done to secure adequate bond with the paving slab and eliminate all voids in the curb.

Curbs shall be formed to the cross section as shown on the drawings with a mule or templates supported on the side forms and with a float not less than 4 feet in length.

The finished surface of the curb and gutter shall be checked by the use of a 10 foot straightedge and corrected if necessary. Where grades are flat and while the concrete is still plastic, the drainage of the gutter should be checked with a 4 foot level.

- B. Separate Curb and Gutter with Tiebars. Separate curb and gutter may be poured prior to pouring the remaining pavement. Tiebars 5/8 inches (5/8") in diameter and 24 inches (24") long shall be cast in the curb and gutter at 30-inch centers as shown on the standard details.
- C. Separate Curb and Gutter with Keyway Separate curb and gutter may be poured prior to pouring the remaining pavement. A keyway of the configuration and dimensions shown on the standard details shall be cast in the curb and gutter section.

1409 SURFACE TOLERANCES. Concrete pavement shall have a surface tolerance in all directions of 1/4 inch in 10 feet when checked with a 10-foot straightedge.

1410 THICKNESS TOLERANCES. It is the intent of these specifications that pavement shall be constructed strictly in accordance with the thickness shown on the plans. The thickness of the pavement may be measured by coring, and where any pavement is found deficient in thickness, it may be compensated for at an adjusted unit price or shall be removed and replaced.

In removing pavement, it shall be removed from the outside edge of the curb and gutter (curb and gutter with tiebars or keyway may remain if in good condition) to a longitudinal joint, or between longitudinal joints, and on each side of the deficient measurement until no portion of the exposed cross sections are more than 2/10-inch (2/10") deficient, except that there shall not be less than 5 linear feet (5') of pavement removed. If there remains less than 10 feet (10') of acceptable pavement between the section that has been removed and a transverse contraction, expansion, or construction joint, the contractor shall remove pavement to the joint.

## SECTION 2000--CONCRETE

2001 SCOPE. This section covers all cast-in-place concrete, including reinforcing steel, forms, finishing, curing, and other appurtenant work.

2002 GENERAL. All cast-in-place concrete shall be accurately formed, and properly placed and finished as shown on the drawings and specified herein.

Where governing specifications are referred to, material and construction requirements shall conform to the governing specification as modified herein. "KHS" shall refer to Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, 1980 edition, or latest revision.

The contractor shall inform the engineer at least 24 hours in advance of the times and places at which the concrete is to be placed.

2003 MATERIALS. All material used in the manufacture of concrete shall conform to the following:

Cement: ASTM C150, Type I, II or III (For concrete pavement see Section 1400)

Water: Clean and free from deleterious substances.

Fine Aggregate: KHS Section 1102, Type FA-A, except that artificial or manufactured sand will not be acceptable.

\*Coarse Aggregate: KHS Section 1102. Additionally, all crushed stone used as aggregate for concrete requiring a 4000 psi strength shall be obtained from quarries and beds designated by the Kansas Department of Transportation as meeting durability requirements of Class 1 or Class 6, as shown on the current listing on file in the office of the city engineer. Certification by an independent testing laboratory that the aggregates used were obtained from an approved source and identifying the name and location of the quarry and bed number shall be filed, at the contractor's expense, with the city engineer.

Curing Membrane: Type 2-White Pigmented compound, AASHTO Designation M148

Air-Entraining Agent: ASTM C260

Admixtures: ASTM C494

Reinforcing Steel: ASTM A615; Bars, Grade 60, Beam stirrups & column ties, Grade 40

Welded Wire Fabric: ASTM A185, and AASHTO Designation M55

- 2004 PRELIMINARY REVIEW. A report shall be submitted to the engineer prior to the placement of concrete and shall include data on proposed use, design strength, concrete mix proportions, maximum water/cement ratio, slump designated at the point of delivery, the percent of air in the concrete for air-entrained concrete, and the fine and coarse aggregate gradation. Mix proportions shall be selected preferably on the basis of field experience and may be adjusted upon approval of the engineer where required to produce concrete of proper workability, uniform consistency, and acceptable density and strength. Failure to get a mix design approved from the engineer prior to concrete placement is just cause for removal of the concrete.

When specifically required by the engineer, a tentative concrete mix shall be designed and tested for each size and gradation of aggregate and for each slump intended to be used on the work. Design quantities and test results of each mix shall be submitted to the engineer for review and approval.

- 2005 CONCRETE MIX DESIGNATIONS. The following tabulation indicates minimum strengths for the various types of concrete which will be accepted.

#### MINIMUM COMPRESSIVE STRENGTH

CLASS	7 DAYS	28 DAYS	SLUMP
I	2000 psi	3000 psi	4 inches maximum
II	2650 psi	4000 psi	2-4 inches maximum

All cast-in-place or precast construction, unless otherwise stated in these specifications or allowed by the engineer, shall be of Class II concrete. When high-early strength cement is to be used for concrete, the mix shall obtain a 7-day strength not less than the minimum 28-day strength specified to concrete of the same class.

- 2006 LIMITING REQUIREMENTS. Each concrete mix shall be designed and concrete shall be controlled within the following limits.

		MAX. SIZE	CEMENT	MAX. WATER	MAX. GALS.
		COURSE	CONTENTS	CEMENT	WATER PER
	SLUMP	AGGREGATE	LBS./C.Y.	WEIGHT RATIO	SACK OF CEMENT
CLASS I (3000 psi)	4"	1"	480	.542	6.12
CLASS II (4000 psi)	2"	1"	558	.421	4.75
	3"	1"	588	.421	4.75
	4"	1"	618	.421	4.75

The quantity of portland cement shall be not less than that shown in the preceding table.

Concrete slump shall be kept as low as possible consistent with proper handling and thorough compacting. Maximum slump for portland cement concrete pavement shall be two inches (2"). Slumps for concrete work other than pavement construction shall not exceed four inches (4"). Use of slumps in excess of those specified shall be only when authorized by the engineer. The use of water to obtain so-called "improved workability" shall not be permitted.

The initial set as determined by ASTM C403 shall be attained 5-1/2 hours, plus or minus one hour, after the water and cement are added to the aggregates. If such use has been approved by the engineer, the quantity of retarding or accelerating admixture shall be adjusted to compensate for variations in temperature and job conditions.

The use of admixtures other than air-entraining agents is discouraged and shall not be allowed without the express approval of the city engineer. When approved for specific purposes the admixture content shall be in accordance with the recommendations of the manufacturer for compliance with these specifications.

The total volumetric air content of concrete after placement shall be six percent (6%), plus or minus one percent (1%).

The minimum acceptable compressive strengths shall be as determined by ASTM C39.

As the work progresses, the engineer reserves the right to change the proportions from time to time if conditions warrant such changes to produce a satisfactory job. Any such changes may be made within the limits of the specifications at no additional compensation to the contractor.

- 2007 BATCHING AND MIXING. Concrete shall be furnished by an acceptable ready-mixed concrete supplier and shall conform to ASTM C94.

The consistency of concrete shall be suitable for placement conditions. Aggregates shall float uniformly throughout the mass and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

- 2008 PLACEMENT. The limits of each concrete pour shall be predetermined by the contractor and shall be acceptable to the engineer. All concrete within such limits shall be placed in one continuous operation.

Before concrete is placed, forms, reinforcements, and embedments shall be rigidly secured in proper position and all dirt, mud, water and debris shall be removed from the space to be occupied by the concrete. Bonding surfaces shall be cleaned of all foreign material and shall be free from laitance. Concrete shall not be placed on frozen subgrade or in excavations which have not been dewatered.

Placement of concrete shall conform to requirements of ACI 304. Concrete shall be placed within forty-five (45) minutes of mixing operations, with the exception that the engineer may extend the period to ninety (90) minutes (maximum) dependent upon weather conditions.

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. Concrete shall not be placed in horizontal layers exceeding eighteen inches (18") and shall not be deposited in large quantities at any point in the forms and then run or worked along the forms, thus causing segregation of the materials. During and immediately

after placement, concrete shall be thoroughly compacted and worked around all reinforcements and embedments and into the corners of the forms. The concrete shall be vibrated or spaded to produce a solid mass without honeycomb or surface air bubbles.

Where steep slopes are required for placing concrete with chutes, the chutes shall be equipped with baffle boards or be in short lengths that reverse the direction of movement. Chutes, troughs and pipes shall not be made of aluminum.

Concrete shall not be dropped in the forms a distance of more than five feet (5'), unless confined by chutes or pipes; and care shall be taken to fill each part of the form by depositing the concrete as near final position as possible. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement.

- 2009 COLD WEATHER CONCRETING. Unless authorized in writing by the engineer, mixing and concreting operations shall be discontinued when the descending air temperature in the shade and away from artificial heat reaches 40°F or when forecast to drop below 40°F within 24 hours of placement, and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35°F.

When concrete work is authorized during cold weather, the aggregates may be heated by methods approved by the engineer prior to being placed in the mixer. No ingredient that is frozen or contains ice shall be placed in the mixer. The temperature of the concrete shall be not less than 60°F and not more than 80°F at the time of placement in the forms. Under no circumstances shall concreting operations continue when the air temperature is less than 20°F. No concrete shall be placed on frozen subgrade. Sudden cooling of concrete shall not be permitted. Concrete injured by frost action or freezing weather shall be removed and replaced at the contractor's expense.

- 2010 HOT WEATHER CONCRETING. The provisions of this section shall apply to all concrete work which is done when the air temperature is above 80°F at the time of placement.

The temperature of the concrete, when placed, shall not be high enough to cause excessive loss of slump, flash set or cold joints. In no case shall the temperature of the concrete, when placed, exceed 90°F. Forms, reinforcing and subgrade surfaces against which the concrete is to be placed shall be wetted down immediately before placement.

When the air temperature exceeds 90°F and as soon as practicable without causing damage to the surface finish, all exposed concrete shall be kept continuously moist by means of fog sprays, wet burlap, cotton mats, or other means acceptable to the engineer. This cooling with water shall be in addition to the initial sealing by membrane curing compound.

- 2011 CURING AND PROTECTION. Concrete shall be cured by protecting it against loss of moisture, rapid temperature changes and mechanical injury for at least four days after placement. Acceptable methods shall be moist curing, white polyethylene sheeting, liquid membrane-forming compounds, or a combination thereof. After concrete finishing operations

have been completed, the entire surface of the newly-placed concrete shall be covered by the curing medium applicable to local conditions and acceptable to the engineer. The contractor shall have the necessary equipment for adequate curing on hand and be ready to install prior to concrete placement.

Moist curing shall be accomplished by a covering of burlap or other approved fabric mat used singly or in combination. Curing mats shall be thoroughly wet when applied and kept continuously wet and in intimate contact with the surface for the duration of the moist-curing period. Burlap or fabric mats shall be long enough to cover the entire surface of the work and lapped at joints to prevent drying between adjacent sheets.

White polyethylene sheets shall be large enough to cover the entire surface of the work and shall be lapped not less than eighteen inches (18"). The sheets shall be adequately weighted to prevent displacement or billowing due to wind. Tear holes appearing in the material during the curing period shall be immediately repaired or replaced with material in acceptable condition.

White membrane curing compound shall be applied after finishing operations have been completed and immediately after the free water has left the surface. The surface of the work shall be completely coated and sealed with a uniform layer of the curing compound at a rate of not less than one gallon per 150 square feet. The compound shall not be thinned and shall be kept agitated to prevent settlement of pigment. On surfaces where forms are removed prior to the end of the specified curing period, the entire exposed surface shall be coated at the specified rate of coverage. If rain falls on the newly-coated surface before the film dries sufficiently to resist damage, or if the film is damaged in any other way, the contractor will be required to apply a new coat of compound to the affected area.

During cold weather concreting when the ambient air temperature is expected to drop below 40°F, a sufficient supply of burlap, straw, hay, or other blanketing material shall be provided along the work to protect the concrete and maintain a minimum temperature of 40°F in the concrete as measured on the surface. An approved moisture barrier such as wet burlap or plastic sheeting shall be placed on the concrete prior to placement of the blanketing material. This type of curing shall be maintained for a period of six days as the initial cure.

Sidewalks, curb and gutter, and miscellaneous concrete shall be protected and cured for a period of not less than seventy-two (72) hours after the placing of the concrete by covering with wet burlap or by the application of a membrane curing compound as specified above.

- 2012 **FORMS**. Forms shall be designed to produce hardened concrete having the shape, lines, and dimensions shown on the drawings. They shall be sufficiently tight to prevent leakage of mortar and shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement.

Forms may be of wood or metal and shall be designed to permit easy removal without injury to the concrete. Forms for all exterior exposed surfaces which will be visible after backfilling shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiberboard. Forms shall be coated with an approved light oil to prevent concrete from adhering and shall be thoroughly cleaned and re-oiled before re-use.

Forms shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads. Care shall be taken in form removal to avoid surface gouging, corner or edge breakage, and other damage to the concrete. The following table gives the approximate minimum time that forms shall be left in place.

AVERAGE AIR TEMPERATURE GREATER THAN	70°	60°	50°	40°
STRUCTURAL MEMBER	TIME IN PLACE (24 HOUR DAYS)			
Slab Shoring	10	12	14	21
Slab Forms	7	7	7	7
Beams Soffits and Shoring	10	12	14	21
Beam Side Forms	1	12	2	3
Wall Side Forms	2	2	3	4

- 2013 **FINISHING FORMED SURFACES**. Fins and other surface projections shall be removed from all formed surfaces except exterior surfaces that will be in contact with backfill. A power grinder shall be used, if necessary, to remove projections and provide a flush surface. Surfaces to be dampproofed shall have fins removed and tie holes filled, but no additional finishing will be required.

Tie holes in all formed surfaces shall be cleaned, wetted, and filled with an expansive cement mortar. Tie hole patches shall be left flush, sound, smooth, even and shall match the texture and color of the adjacent concrete.

Unless provided otherwise in the plans all exposed edges shall be beveled by using dressed, triangular molding, having three-fourths inch (3/4") sides.

- 2014 REPAIRING DEFECTIVE AND DAMAGED CONCRETE. Any concrete found not to be formed as indicated on the plans, or out of alignment or level, or having a defective surface, or damaged prior to acceptance of the project by the city, shall be considered as not conforming to the intent of these specifications and may be ordered removed and replaced by the contractor at his expense unless the engineer authorizes patching of the defective or damaged area. Surface defects such as ridges and bulges shall be removed by grinding.

Honeycombed and other defective concrete that does not affect the structural integrity of the structure shall be chipped out and the vacated area shall be filled. The methods used in this type of repair shall be approved by the engineer. Material used for patching shall be a non-shrink, non-metallic grout with a minimum 28-day compressive strength of 5000 psi or a similar material approved by the engineer. Prior to placement of the repair filling, the contact surface of the affected area shall be thoroughly cleaned of all loose and foreign material and shall be coated with an epoxy bonding agent.

Concrete repair work shall conform to Chapter 9 of ACI 301 and shall be performed in a manner that will not interfere with thorough curing of surrounding concrete. Repair work shall be adequately cured and protected from further damage.

- 2015 REINFORCEMENTS. The metal reinforcement shall be protected by the thickness of concrete indicated on the construction drawings. Where not otherwise shown, the thickness of concrete over the reinforcement shall be as follows:

LOCATION OF REINFORCEMENT	COVER
Surfaces where concrete is deposited directly against the ground	3 inches
Formed surfaces exposed to the ground, to water, or to weathering	2 inches
Beams, girder, and columns not exposed to ground, water, or weathering	1-1/2 inches
All surfaces other than those above	1 inch

Reinforcing steel shall be accurately placed and positioned on supports, spacers, hangers, or other reinforcing steel as approved by the engineer and shall be secured in place with wire ties or suitable clips. The minimum clear distance between parallel bars shall not be less than 1-1/2 times the diameter of round bars, except that in no case shall clear spacing between parallel bars be less than 2 inches or less than 1-1/2 times the nominal size of the coarse aggregate.

Splices in reinforcing steel will not be permitted at points of maximum stress. When it becomes necessary to splice reinforcing steel at points other than those shown on the contract drawings, the character and location of the splice shall be approved by the engineer. Welding or tack welding of reinforcement will not be permitted. Reinforcements upon which unauthorized welding has been done shall be removed and replaced as directed by the engineer. Spliced bars shall be placed in contact and securely tied together.

Metal reinforcement at the time concrete is placed shall be free from rust, scale, or other contaminants that will destroy or reduce the bond.

2016 CONSTRUCTION JOINTS. Construction joints shall be made at locations indicated on the drawings or specified, and shall conform to the requirements of ACI 318. When the contractor desires to make construction joints at other locations, he shall anticipate such changes far enough in advance of the construction operations to allow the engineer to investigate such changes and approve additional construction joints.

2017 EXPANSION AND CONTRACTION JOINTS. Expansion and contraction joints shall be at locations indicated on the drawings or as specified.

Contraction joints shall consist of planes of weakness created by forming or cutting grooves in the surface of the concrete. Formed grooves shall be made by depressing an approved tool or device into the plastic concrete. Sawed joints shall be constructed by sawing through the surface of the concrete with an approved concrete saw. Sawing of the joints shall begin as soon as the concrete has hardened sufficiently to prevent excessive raveling.

Expansion joints shall be formed with pre-formed expansion joint filler of the non-extruding and resilient types which shall include the following; Cork, self-expanding cork, sponge rubber, cork rubber, and bituminous fiber. These materials shall meet the requirements of ASTM D994, D1751 and D1752.

2018 REINFORCED CONCRETE BOX FORMING SEQUENCE. Wall forms may be placed the day following the placement of the bottom slab, as long as care is taken to protect the slab against rough or abusive handling of forms and or placing equipment. The actual placement of concrete shall not occur prior to the fifth day after placing the bottom slab. Top forms may be placed with wall forms if the walls and top are to be monolithic construction, otherwise top forms are not to be placed until the third day after placing the walls. The actual placement of concrete for the top shall not occur prior to the fifth day after placing the walls (for base to top shoring) or until the walls have reached their design strength for slab forms shored by the walls. Wall forms shall remain in place a minimum of two days after the walls are poured. Supports for the top slab shall be left in place according to the schedule shown in this section, paragraph 2012--*Forms*.

The above guidelines for placing forms for reinforced concrete boxes are based on the use of standard forming procedures and with the use of concrete containing no admixtures to achieve high early strength. Variations in forming techniques and/or the use of high early strength concrete shall only be allowed after the contractor obtains the written approval of the city engineer.

## SECTION 2100-CONCRETE CURB, CURB AND GUTTER, SIDEWALK, AND DRIVEWAY ENTRANCES

- 2101 SCOPE. This section covers concrete curb, curb and gutter, concrete sidewalk and concrete driveway entrances, including reinforcing steel, forms, joints, finishing, curing, and other appurtenant work.
- 2102 MATERIALS. All items of material included in this work shall conform to the requirements of Section 2000 *Concrete*.
- 2103 GENERAL. All construction covered in this section shall conform to the requirements of Section 2000 *Concrete*. All curb or curb and gutter construction shall be performed prior to placement of pavement or sidewalk, except when otherwise approved by the engineer. All forms shall be in good condition with not more than one-fourth (1/4) inch variation in horizontal and vertical alignment for each ten (10) feet in length.
- 2104 GRADING AND SUBGRADE PREPARATION. All excavation required in the grading and subgrading preparation shall be considered as "Unclassified Excavation" as defined in Section 1100 *Grading*. All grading shall be done in conformance with Sections 1100 *Grading* and 1200 *Subgrade Preparation*.
- 2105 EXPANSION AND CONTRACTION OR CONSTRUCTION JOINTS. Expansion and contraction or construction joints shall be as herein specified on the standard detail sheets or as otherwise specified by the city engineer.
- 2106 FINISHING. Finishing shall be performed as follows:
- a. Curb and Curb and Gutter. The curb shall be tooled to the required radii as soon as possible after the concrete takes its initial set. After the forms and templates are removed the joints shall be tooled and the curb surface finished with a wood or cork float to remove all imperfections without additional mortar. In all cases the resulting surface shall be smooth and of uniform color with all rough spots, projections, and form stakes removed. No plastering of the concrete will be allowed. The finished curb shall have a true surface, free from sags, twists, or warps, and shall have a uniform appearance, and shall be true to the specified lines, grades, and configurations shown on the drawings.
  - b. Sidewalk and Driveway Entrances. After the concrete has been thoroughly consolidated and leveled, and the initial set has taken place, the surface shall be finished with a soft wood or cork float and either burlap or broom finished with no other mortar than that contained in the concrete. The resulting surface shall be uniform in color and contain no imperfections. The edges shall be rounded with a tooling edge. Special care shall be taken to ensure a straight, neat appearance along the edges of the sidewalk or driveway entrance and at the joints.

- 2107 REINFORCEMENT (Curb and Gutter). Reinforcement for concrete curb and gutter shall be as designated on Standard Details 21-1 and 21-2. The exception to this shall be when the curb and gutter is to be constructed on an asphaltic concrete base with a minimum depth of three inches (3"). In this case, no reinforcement shall be required unless otherwise determined by the city engineer.
- 2108 REINFORCEMENT (Other). Reinforcement for all other work shall be as shown on the contract drawings or as depicted on details contained in this specification.

## SECTION 3000 - SANITARY SEWERS

3001 SCOPE. This section applies to sanitary sewer construction and shall consist of furnishing all labor, materials, and equipment for the complete installation of sewers and appurtenances.

3002 GENERAL. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the contract documents.

When reference is made to a standard specification (ASTM, AWWA, etc.), the specification referred to shall be understood to mean the latest revision of said specification except as otherwise noted in the contract documents.

3003 MATERIALS.

### A. Reinforced Concrete Pipe

Pipe	ASTM C76, except as modified herein.
Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand will not be permitted.
Cement	ASTM C150, containing not more than five percent (5%) tricalcium aluminate.
Gaskets	ASTM 361 polymer shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable.

### B. Ductile Iron Pipe

Pipe	ANSI A21.51; ASTM A536, Grade 60-42-10, Thickness Class 50 unless otherwise required by the City Engineer.
Mechanical and Push-On Joint	ANSI 21.11, except gaskets shall be neoprene or synthetic rubber. Natural rubber will not be acceptable.
Flanged Joints	ANSI A21.10.
Fittings	ANSI A21.10, pressure rating of not less than that specified for pipe.

Lining & Coating Lining application shall be performed by pipe manufacturer only. Jobbing of lining will not be allowed. All lining shall be done at point of pipe manufacture.

1. Polyethylene Lining:

All pipe and fittings shall be lined with virgin polyethylene complying with ASTM D1248, compounded with an inert filler and with sufficient carbon black to resist ultra-violet degradation during aboveground storage of the pipe and fittings. The polyethylene lining shall be bonded to the interior of the pipe or fitting by heat.

Polyethylene linings for pipe and fittings shall have a nominal thickness of 40 mils. Minimum lining thickness shall be 30 mils. Linings shall cover the interior surface of pipe and fittings in conformance with the following:

The lining for pipe utilizing push-on gaskets shall extend from the spigot and through the socket to the edge of the gasket sealing area. The lining for pipe utilizing mechanical joints shall extend from the spigot and through the socket to the edge of the gaging ring. The lining in fittings shall cover the interior surfaces including the socket areas as defined above.

2. Calcium Aluminate Lining:

Before lining the pipe with cementitious material, a portion of the gasket cavity and a portion of the pipe barrel shall be coated with a minimum of 8 mils of Tnemec Series 61-D1182 black epoxy. The bell end portion to be epoxy coated starts with the gasket seating area, continues through the bell shoulder, and concludes with the first 4 inches of the pipe barrel interior. The spigot end shall be epoxy coated on the interior and exterior surfaces.

The lining shall be a pure fused calcium aluminate mortar comprised of fused calcium aluminate cement combined with fused calcium aluminate aggregates. A seal coat shall be applied to the lining.

The thickness of the lining shall be a minimum of 0.125 inches (125 mils) for 6" through 12" pipe, 0.187 inches (187 mils) for 14" through 24" pipe. The lining thickness may taper to less than the specified minimum at the ends of the pipe.

Field-cut end repairs are to be done in accordance with the pipe manufacturer's recommendations. End repairs are limited to exposed metal within the pipe joint. The calcium aluminate cement lining does not require sealing or protection.

Cracks, other than closed hairline cracks and/or fine crazing, shall not be acceptable. Loose areas of cement are not allowable. Visual inspection of the lining is sufficient.

### C. Polyvinyl Chloride (PVC) Pipe

Pipe*	Pipe shall be seamless. Pipe material shall conform to ASTM D 1784 and shall have a minimum cell classification of 12454B, 12454C, 12364A, or 13364B. Pipe sizes 18" and less shall conform to ASTM D-3034 or ASTM F-789. Pipes larger than 18" shall conform to ASTM F-679 or F-794. Minimum pipe stiffness for pipe used for stublines and for pipes with depths to invert up to 15 feet shall be SDR <b>35</b> . SDR <b>26</b> shall be used for pipes with depths to invert greater than 15 feet.
Joints	All gasketed joints shall be compression, bell and spigot push-on conforming to ASTM D 3212-89 "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals", conforming to ASTM F 477. Lubricant shall be as recommended by the pipe manufacturer.
Fittings	Fittings defined as tee connections suitable for assembly to 6-inch house or building sewers shall be saddle-type fittings molded of PVC materials conforming to ASTM D 1784. All fittings shall utilize Elastomeric seals and shall be suitable for use with the respective ASTM PVC pipe standard or molded PVC. Insert-a-tee is acceptable for service connections on 12" and larger service mains.

\*When PVC is used on force mains, a tracer wire shall be installed allowing accurate locates of the main.

- 3004 ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings using laser beam equipment, surveying instruments or batter boards to maintain alignment and grade. If batter boards are used, they shall be erected at intervals not exceeding 25 feet. Not less than three batter boards shall be maintained in proper position at all times during the trench grading operation.
- 3005 HANDLING. Pipe, fittings, and appurtenances shall be transported, unloaded, stockpiled, distributed, and installed or otherwise handled in a manner which prevents damage thereto and

which will ensure the delivery and installation thereof in a sound and acceptable condition. Hooks shall not be permitted to contact joint surfaces. Damaged pipe shall be removed from the site.

- 3006 CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Whenever pipe laying is stopped, the open end of the pipe must be closed by using a pipe plug to prevent trench water, sand, and earth from entering the pipe. In no case shall said plug be removed and water allowed to enter the sewer until the Engineer is satisfied that the sewer will not be injured by water coming in contact with the pipe, pipe backfill or subgrade. The Engineer may require the contractor to pump the water from the trench before continuing trenching or pipe laying operations.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

- 3007 LAYING PIPE. Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying except when reverse laying is permitted by the Engineer.

- 3008 JOINTING. All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe. The position and condition of each rubber gasket (unbonded gaskets) shall be checked with a feeler after the joint is completed.

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361 except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Joints for PVC pipe shall comply with all recommendations and instructions of the pipe manufacturer.

- 3009 TEMPORARY PLUGS. Provide and install plugs as manufactured by pipe supplier or as fabricated by contractor of approved construction. Plugs shall be watertight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

Mechanical plugs, braced with a 4x4 timber wedged against the opposite wall of the manhole, shall be installed at the downstream end (connection with existing line) on all sanitary sewer extension projects under construction and shall be verified by the contractor at the completion

of each working day. Also, the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.

- 3010 CONNECTIONS TO EXISTING PIPELINES AND STRUCTURES. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.

Prepare structure by making an opening with at least two inches (2") clearance all around fitting to be inserted. The concrete structure shall be initially cut with a concrete saw in conformance with the method and tolerances shown on city standard drawings. Opening between pipe and manhole wall shall be filled with an expansive grout in such a manner that a watertight condition will result.

Manholes to be built on an existing sewer shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls, and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the contractor shall be repaired or replaced at no expense to the city.

Connections between different pipe materials shall be made using proprietary transition coupling, unless otherwise specified on the drawings.

- 3011 TEE BRANCHES AND SADDLES. Tee branches and saddles shall be pitched at 45° and installed at locations designated on the plans. The contractor shall verify that tee branch or saddle locations have been marked in advance of the construction of sewers serving any property which will require sewer service and, if the locations have not been designated, shall stop the sewer construction until the necessary tee branch or saddle locations have been obtained.

Tee branches and saddles shall be installed with the lower lip not more than two inches (2") below the outside top of the pipe. Tee branches or saddles shall not be covered until each location has been recorded.

Each tee branch or saddle shall be marked with a wooden strip extending from the tee vertically to within one foot (1') of the ground surface. **All service line branches shall be extended to within 8 feet of the minimum sewerable floor elevation at the time of the main construction.** Markers shall be securely anchored and maintained vertical until backfilling has been completed. Tee branches or saddles shall be closed with a suitable plug held in place by an approved joint sealing compound.

3012 SERVICE CONNECTIONS. Service connections made to the sewer prior to backfilling shall not be installed as vertical risers but shall be laid on a slope not to exceed one foot vertical to one foot horizontal. A 45° bend shall be used to join the tee branch to the service connection or stub line. The service pipe shall make such a horizontal angle with the sewer line that a proper connection to the 45° bend or stub line is obtained without trimming the pipe and with no danger of jute or jointing material being forced into the sewer. Each service connection pipe shall have a solid bearing on rock backfill.

3013 CONCRETE ENCASEMENT. Concrete encasement shall be installed as shown on the drawings and where, in the opinion of the Engineer, such pipe encasement is necessary because of unforeseen conditions encountered in the work. All pipe which is to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation. The minimum 28-day compressive strength of concrete used for encasement of sewer lines shall be 3000 psi.

3014 WATER LINE CLEARANCES

GRAVITY SANITARY SEWERS - When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 ft (3.0 m). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10 ft (3.0 m) separation, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer. Equivalent protection may require sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as polyethylene or cured-in-place.

When a water pipe and a sanitary sewer cross and the sewer is 2 feet (0.6 m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to Chapter VI of the KDHE Minimum Standards of Design of Water Pollution Control Facilities.

- Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push-on or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA c111/A21.11.
- PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, ASTM F789, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.
- Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2 feet (2'/0.6 m) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of six inches (6"/15 cm) thickness for a 10 foot (10'/3.0 m) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. KDHE will consider proposals providing equivalent protection by other means on a case-by-case basis, if supported by data from the design engineer.

Where sanitary sewer lines are to be installed under and across water lines and a two foot (2') clearance cannot be obtained because of limiting grades or grades of existing structures, then the sewer line shall be constructed of ductile iron pipe for a distance of at least ten feet (10') in each direction from the crossing.

**SEWER CONNECTIONS.** There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs, or distribution systems.

**PRESSURE SEWER LINES.** When force mains run parallel to water lines, the separation distance shall be as far as practical, but at least a 10 ft (3.0 m) horizontal separation shall be maintained. There shall be at least a 2 ft (0.6 m) vertical separation at crossings with the water main crossing above the sewer force main. In cases where it is not practical to maintain the required vertical or horizontal separation distance between a water line and a sanitary sewer force main, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer.

**SEWER MANHOLES.** No water pipe shall pass through or come in contact with any part of a sewer manhole.

**STORM SEWERS.** The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main should be based on geotechnical considerations.

**DRAINS.** Underground drains from fire hydrants or valve pits should not be directly connected to sanitary or storm drains.

All of the above recommended protective measures shall apply to water and sewer service lines.

All special protective measures outlined by KDHE shall be required in the final design and implemented during the construction phase when it is impractical for geotechnical reasons, to cross water lines over sewer lines.

3015 **SEWER MANHOLES.** Manhole construction shall comply with all of the applicable requirements of Section 3100 *Sanitary Sewer Manholes*.

3016 ACCEPTANCE TEST. Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of the Engineer by and at the expense of the contractor.

- A. Infiltration Test. An infiltration test will be required when the sewer line is below the ground water level. The amount of water leaking into the sewer shall be measured and it shall not be more than 50 gallons per day per mile of pipe, per inch nominal diameter.
- B. Exfiltration Test. In areas where the ground water level is below the pipe, the contractor shall perform an exfiltration test. The section of sewer to be tested shall be filled with water so that the water level in the upstream manhole is at least four feet (4') above the flow line or two feet (2') above the top of the pipe, whichever is greater.

The amount of water added during the test period to maintain the water level shall be measured and it shall not exceed a rate of 50 gallons per day, per mile of pipe, per inch nominal diameter.

- C. Air Test. As an alternate to the exfiltration test, the contractor may perform a low pressure air test when approved by the Engineer. The section of pipe between successive manholes shall be sealed with suitable plugs. One of the plugs shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge having a range from 9 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of  $\pm 0.04$  psi. Reinforced concrete pipe shall not be air tested.

Low pressure air testing shall be conducted on all lines unless otherwise directed by the City Engineer. The testing methods and air leakage rates shall conform to the requirements of ASTM F-1417-92 or the latest revision thereof. Each reach of sewer pipe between manholes shall be tested after completion of the installation of the pipe, appurtenances and the backfill of the sewer trench. Internal air pressure shall be monitored so that it will not exceed 9.0 psig.

Determine the rate of air loss using the time-pressure drop method. Slowly introduce air into the section of pipe to be tested, until the air pressure is raised to approximately 4.0 psig and the section of pipe section is stabilized. As discussed previously, disconnect the air supply and decrease the pressure to 3.5 psi before starting the test. Determine the time required for the pressure to drop from 3.5 psi to 2.5 psi and compare this interval to the required time to decide if the rate of air loss is within the allowable minimum times required by pipe diameter are shown in Table 1.

If the pressure drops 1.0 psi before the appropriate time shown in Table 1, the air loss rate shall be considered excessive and the test section fails. If the test section fails, leaks shall be repaired and the line shall be retested to the requirements of this test method. **“Fernco” rubber clamp-on type repair couplers will not be an acceptable method of repair.**

**Solid repair sleeves shall be used on all new construction.** Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low pressure air test.

Upon completion of the test, open the bleeder valve and allow air to escape. Plugs should not be removed until all air pressure has been reduced.

Example of how to use Table 1:

What should the required test time be for a 1.0 psig pressure drop in 327 feet of 8-inch diameter pipe between manholes.

Solution:

The exact time is easily calculated by using Table 1. Since 327 feet exceed the 298 feet length associated with the minimum test time for an 8-inch pipeline, the fourth column in Table 1 is used to calculate the required test time as follows:

$$T = 1.520 \times L = 1.520 \times 327 = 497s$$

Therefore, the required test time for a 1.0 psig pressure drop is 497 s or 8 minutes and 17 seconds.

ASTM F 1417

TABLE 1

Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015

Note 1--See Practice UNI-B-6-90

Note 2--Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter

Pipe Diam. In	Min. Time min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

In areas where ground water is known to exist, a one-half inch diameter capped pipe nipple approximately 10 inches long is to be installed through the manhole wall on top of one of the sewer lines entering the manhole. This installation is to be done at the time the sewer line is constructed. Immediately prior to the performance of the line acceptance test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground to clear it and then connecting a clear plastic tube to the pipe nipple. The tube shall then be held vertically and a measurement of height in feet of water shall be taken after the water height has stabilized in the tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure to be added to all readings.

All pressure sewage force mains shall have hydrostatic pressure and leakage tests performed prior to acceptance. No pressure sewer line shall be accepted unless passing the prescribed requirements. All tests shall conform to AWWA C600 procedures as modified herein and shall be applicable to all pressure sewers. The test shall be conducted after line installation and trench backfilling is complete.

The test shall be performed separately in segments between sectionalizing valves and a test plug, or between test plugs. Test segments shall be selected so that adjustable seated valves are isolated for individual checking. The contractor shall furnish and install test plugs at no additional cost to the owner, including all required anchors, braces and other devices to withstand hydrostatic pressure on the lugs. Any damage to public or private

property caused by failure of the plugs shall be the responsibility of the contractor. The fill rate of the line shall be limited to the available venting capacity.

The pressure test shall be conducted at 1.5 times the maximum operating pressure determined by the following formula:

$P_{pt} = 0.650 (OP - GE)$ , in which

$P_{pt}$  = test pressure in psi at gauge elevation

$OP$  = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line.

$GE$  = elevation in feet at center line of gauge.

The test shall be performed satisfactorily prior to determining leakage.

The leakage test shall be conducted at maximum operating pressure as determined by the following formula:

$P_{lt} = 0.433 (OP - GE)$ , in which

$P_{lt}$  = test pressure in psi at gauge elevation

$OP$  and  $GE$  = as in pressure test

All joints shall be watertight and free from leaks as determined by the test.

If any of the above tests fail to meet the above prescribed requirements, the test shall be repeated as necessary after all leaks and defects have been repaired.

- E. Deflection Test. A deflection test shall be required on all installations involving flexible or semi-rigid pipe after said pipe has been laid and backfilled. The maximum allowable deflection shall not exceed 5.0 percent (5%) of the pipe's actual internal diameter as measured in the field. The deflection test shall consist of guiding a device of the appropriate size for the pipe involved to accurately measure any deflection in the pipe. The device to be used shall be approved by the City Engineer prior to its use. Attention is directed to the fact that the pipe's nominal diameter is greater than the actual internal diameter of the pipe. Lamping will not be approved as a substitution for deflection testing.

Upon completion of the testing, all piping showing a deflection greater than 5.0 percent (5%) shall be excavated, replaced, backfilled, and retested to the satisfaction of the Engineer.

- F. Video tapes. The contractor will be required to provide video tapes to the city after all testing of the sewer line is complete. The video camera shall be placed in the downstream manhole for each section and pulled to the upstream manhole. If services lines or service stubs have been installed with the project, each service must be noted as a distance in feet from the downstream manhole. The completed video tape must include monitoring of distance in feet from the downstream manhole for all sections of pipe installed. The city will complete a second video of the sewer pipe prior to the expiration of the two year maintenance bond. If any maintenance is required during the two year maintenance period, the contractor will be required to video all repaired sections of pipe to verify corrections.

## SECTION 3100--SANITARY SEWER MANHOLES

3101 **SCOPE.** This section covers standard, drop, and special sewer manholes. Manholes shall be constructed complete with covers, steps, fittings, and other appurtenances, in accordance with the details indicated on the drawings.

At the option of the contractor, standard and drop manholes shall be constructed of precast concrete sections or cast-in-place concrete.

Only manholes which are required to have outside pipe and fittings for dropping sewage into the lower line will be designated as drop manholes. Inside drop manholes where the incoming line discharges directly into the manhole and which do not require special fittings will be considered standard manholes.

Manholes shall be placed in locations that will not be in conflict with future sidewalk or driveway construction.

### 3102 **MATERIALS.**

<b>Concrete</b>	Materials, handling, forms, finishing, curing, and other work as specified in Section 2000 <i>Concrete</i> .
<b>Precast Sections</b>	Circular precast concrete; ASTM C478, except as modified. Joints shall be of a bitumastic material or preformed flexible joint sealant applied in accordance with manufacturer's recommendation. A-Lok pipe to manhole connectors or approved equal are required for all manhole connections up to a pipe diameter of 36".
Minimum Thickness	As indicated on the drawings.
Reinforcement	As indicated on the drawings.
Openings	Circular or horseshoe-shaped box-out for each connecting pipe, with surfaces grooved or roughened to improve mortar bond Where manholes are constructed over existing lines, water stop gaskets shall be required.
<b>Portland Cement</b>	ASTM C150
<b>Sand</b>	Concrete sand (fine aggregate) sieved through 8 mesh screen
<b>Shrinkage-Correcting Aggregate</b>	Master Builders "Embeco", Sika "Kemox", or Sonneborn "Ferrolith G-DS".
<b>Mortar</b>	One part portland cement Type II, 3 parts sand, 1/4 part hydrated lime, ASTM C-207.
<b>Non-Shrinking Mortar</b>	Premixed or job mixed; job mixed shall be one part shrinkage-correcting aggregate, one part portland cement, one part sand.
<b>Flat Wrap</b>	Approved material: EZ Wrap, Rubber (Press-Seal Gasket Corp.) or equal.
<b>Gaskets</b>	
Mastic	Hamilton-Kent "Kent-Seal No. 2" (minimum two-1" or one-2" beads per joint), or approved equal. Enough material shall be applied to fill the joint so that a minimum of 1/4-inch bead is visible, to be smoothed off after completion.
Flexible Joint	Preformed "O" ring; butylrubber or bituminous polymer are acceptable. Natural rubber is not acceptable

<b>Coal Tar Paint</b>	Koppers "Bitumastic Super-Service Black," Porter "Tarmastic 103," Tnemec "450 Heavy Tnemecol," or approved equal
<b>Castings</b>	ASTM A48, with asphalt varnish coating applied at the foundry

- 3103 **STANDARD MANHOLES.** All manholes shall be constructed, complete with covers and ladder steps, in accordance with the details shown on the drawings and found herein. Standard manholes above the foundations, unless otherwise required by the plans, shall be constructed of poured-in-place concrete or solid, precast, curved segmental concrete masonry units of circular sections specially cast for use in manhole construction. Manholes shall be constructed with eccentric cones unless otherwise approved by the city engineer.

Foundations for all standard manholes shall have a minimum 28-day compressive strength of 3000 psi.

Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.

Prior to backfilling, every joint shall be flat wrapped with approved material.

- 3104 **CONSTRUCTION.** All mortar shall be used within 40 minutes after mixing. Mortar which has begun to take on initial set shall be discarded and shall not be mixed with additional cement or new mortar.

Manhole inverts shall be constructed of concrete conforming to the requirements of Section 2000 *Concrete*, with the exception that the concrete shall have a minimum 28-day compressive strength of 3000 psi.

In no case shall the invert section through a manhole be greater than that of the outgoing pipe. The shape of the invert shall conform exactly to the lower half of the pipe it connects. Side branches shall be connected with as large of a radius of curve as practicable. All inverts shall be troweled to a smooth clean surface.

Circular precast sections shall be provided with a mastic gasket or preformed flexible joint to seal joints between sections. The space between connecting pipes and the wall of precast sections shall be completely filled with non-shrinking mortar.

All manholes under construction shall be covered in an appropriate manner to prevent the entry of any stormwater runoff, trench water, sand, earth or any other foreign substances at any time during construction or while the manhole is unattended.

- 3105 **DAMPPROOFING.** Surfaces to receive paint shall be dry. Before backfilling is started, the exterior surfaces of precast and poured-in-place manholes shall be painted with two (2) heavy coats of coal tar paint. Application shall be in accordance with the manufacturer's specifications and instructions.

- 3106 **CASTINGS.** Manhole rings and covers shall be Clay and Bailey No. 2008 BV, Deeter No. 1315, GCI castings SM2202, or approved equal. The exception shall be for use on shallow

manholes where manhole covers shall be Clay & Bailey No. 2020, Deeter No. 2016, GCI castings SM 2100, or approved equal.

When bolt-down type manhole rings and covers are required and specified, Clay and Bailey No. 2014 M, GCI Casting SB 2200STD, or approved equal, with rubber gaskets and stainless steel cover bolts 5/8-inch diameter with hexagonal-head bolts shall be furnished. Bolt-down type manhole rings shall be anchored to the manhole with not less than four 3/4-inch diameter anchor bolts having a minimum of 14 inches (14") of embedment, except in concrete manholes in which the ring is embedded in concrete.

If castings arrive on the job without a foundry coating, one coat of coal tar paint shall be applied. Before painting, all castings shall be thoroughly cleaned and properly supported. All loose rust shall be removed by wire brushing. Castings shall not be handled until the paint is dry and hard. All castings shall be interchangeable with the Clay and Bailey model numbers.

Prior to backfilling, casting and adjusting rings shall be flat wrapped with approved material.

- 3107 STUBLINES. Stublines for future sewer main connections shall be provided in manholes at the locations indicated on the drawings and shall terminate in a bell and plug.
- 3108 CONNECTIONS TO EXISTING MANHOLES. All sewers constructed of rigid pipe extending from manholes shall be encased with concrete to the first pipe joint from the manhole. A rubber gasket water stop shall be required for all rigid and flexible pipe connections.
- 3109 PLASTIC MANHOLE STEPS. Polypropylene coated steel reinforced steps "plastic steps" shall be M.A. Industries, Inc., model PS-2-PF, American Step Company, Inc., model ML-13 or approved equal manhole step for precast concrete manholes.
- 3110 GRADE RINGS. All manholes shall be fitted with an adjusting ring or rings providing a minimum adjustment of four inch (4") and a maximum adjustment of twelve inches (12") and one adaptor ring between the cone section and the casting in conformance with Detail 31-6.
- 3111 ACCEPTANCE TESTING. Vacuum tests shall be conducted on all newly constructed manholes and existing manholes that have been repaired or restored or manholes constructed over existing sewers.

All lift holes shall be plugged with a non-shrinking mortar, as approved by the engineer. The contractor shall plug all pipes connected to the manhole using pneumatic plugs. The pneumatic plugs should be placed into the pipe after the inside surface has been cleaned. Air shall be introduced into the plugs to 25 psig. Bracing can be used to ensure that the plugs are not pulled into the manhole during vacuum testing. After the manhole has been properly prepared, the vacuum tester shall be installed. The test head shall be placed on top of the casting or fit inside the casting in a manner which incorporates the casting and all adjusting and adaptor rings into the vacuum test. The vacuum pump shall be connected to the outlet port with the valve open. The outlet valve shall be closed after a vacuum draw of 10 inches of Hg. has been obtained. The test shall pass if the vacuum remains at 10 inches Hg. or drops to 9 inches Hg. in a time greater than one minute. If the manhole fails, the contractor shall locate the leak and make proper repairs and then re-test.

The manhole vacuum tester shall be as manufactured by P.A. Glazier, Inc., or approved equal. The pneumatic plugs, a part of Cherne Air-Loc Equipment as manufactured by Cherne Industrial of Hopkins, MN., or approved equal. These plugs shall have a sealing strength equal to or greater than the diameter of the connecting pipe to be sealed. A visual inspection will be performed for each manhole by the engineer after the manhole has met the requirements of the vacuum test and is considered in its final state. The inspection shall determine the completeness of the manhole. Any defects identified shall be repaired to the engineer's satisfaction.

## SECTION 4000--STORM SEWERS

4001 **SCOPE.** This section covers the furnishings of all labor, materials, and equipment for the complete installation of storm sewers and appurtenances in accordance with the contract documents. The work shall consist of the construction of storm sewers for the removal of water from collection points, in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the contract drawings or established by the engineer. Unless otherwise indicated in these specifications, the phrase "Storm Sewer" shall refer to pipe sewers, box culvert sewers, or paved or rock lined channels.

4002 **REINFORCED CONCRETE PIPE.** All reinforced concrete pipe shall conform to ASTM C76, Class III. This specification covers reinforced concrete pipe of 15- to 108-inches in diameter and is intended for use in conveyance of storm water and for the construction of culverts.

Installation shall conform to the requirements of Section 6000 *Excavation, Trenching, and Backfilling*. No pipe culverts shall be placed until the embedment below the proposed reinforced concrete pipe have been approved by the engineer.

4003 **CORRUGATED METAL PIPE.** Corrugated metal storm sewer pipe shall be furnished with connecting bands, elbows, and fittings. Corrugated metal storm sewer pipe shall have annular ends. The same type of pipe base metal (steel or aluminum) shall be used throughout any individual run or installation of pipe or for pipe extensions. Materials shall conform to the requirements provided in the current edition of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation. **All Ultra-Flo pipe shall be aluminized type 2.**

Corrugated metal culvert pipe gauge requirements shall conform to Design Aids 4-1 and 4-2 of the Design Criteria. In no case shall any pipe be lighter than 16 gauge.

Corrugated metal storm sewer pipe shall be handled in such a manner that it is not chipped, dented, or bent. If in handling the culvert the base metal is exposed in any way, it shall be rejected or repaired to the satisfaction of the engineer.

The excavation, trenching, and backfilling of corrugated metal pipe storm sewers shall be performed in accordance with the requirements of Section 6000 of these specifications. No pipe culverts shall be placed until the embedment below the pipe has been approved by the engineer.

A. **CORRUGATED METAL PIPE; ALUMINIZED TYPE 2:** Sheet steel for aluminized CMP shall conform to ASTM A-929 or AASHTO M-274. Pipe manufacture shall conform to ASTM A-760 or AASHTO M-36. Fitting shall be fabricated from the same material as the pipe.

- 4004 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE. This specification applies to high density polyethylene corrugated pipe with an integrally-formed smooth interior. This specification is applicable to nominal sizes 12- to 60-inch diameter. Requirements for test methods, dimensions, and markings are those found in AASHTO Designation M-294, Type S. Pipe and fittings shall be made of polyethylene compounds which meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D-1248 with the applicable requirements defined in ASTM D-1248. Clean rework material may be used.

The pipe and fittings shall be free of foreign inclusion and holes, and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely effect joining.

The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. Corrugated fittings may be either molded or fabricated by the manufacturer. Fittings produced by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the city engineer. Joints shall be made with integral bell or split couplings, corrugated to match the pipe corrugations, and engage a minimum of 4 corrugations. A neoprene gasket shall be utilized with the coupling to provide a soil-tight joint. Installation shall be in accordance with Section 6000 of these specifications. A manufacturer's certifications that the project was manufactured, tested, and supplied in accordance with this specifications shall be furnished.

- 4005 CATCH BASINS, INLETS, AND JUNCTION BOXES. The methods of excavation and backfilling for catch basins, inlets, and junction boxes shall conform to the requirements of Section 6000 *Excavation, Trenching, and Backfilling* and Standard Details of these specifications.

Reinforced concrete catch basins and inlets shall conform to the standard concrete inlet drawings and shall be constructed of concrete having a minimum 28-day compressive strength of 4000 psi. Concrete cover over steel reinforcement shall be not less than 1-1/2 inches for covers and 1-1/2 inches for walls and floors. All exposed concrete shall have smooth steel trowel or brushed finish. Interiors of structures shall have the forms removed and surface voids filled.

Foundations for all standard catch basins and inlets shall have a minimum 28-day compressive strength of 3000 psi.

The floors of all catch basins, inlets, and junction boxes shall have inverts. Inverts shall be constructed of concrete conforming to the requirements of Section 2000 *Concrete*, with the exception that the concrete shall have a minimum 28-day compressive strength of Class I 3000 psi.

All catch basins, inlets, pipes, and junction boxes shall be thoroughly cleaned of any accumulation of silt, debris or foreign matter of any kind, and shall be free from such accumulations at the time of final inspection.

- 4006 REINFORCED CONCRETE BOX CULVERTS. The work performed herein covers the installation of concrete work in strict accordance with the applicable provisions of Section 2000 *Concrete*, Section 6000 *Excavation, Trenching, and Backfilling*, Standard Details, all of these

specifications, the current edition of the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation, and the applicable contract drawings.

- 4007 PAVED DITCHES AND RIPRAP Paving concrete for paved ditches shall conform to the applicable provisions of Section 2000 *Concrete* of these specifications and shall conform to the standard drawings or approved equal.

The concrete shall be placed beginning at the lower end of the portion of the ditch to be lined and progressing toward the upper end. If required on the contract drawings, the concrete shall be reinforced with the type of reinforcement and in the manner indicated. Contraction or construction joints shall be spaced and formed as indicated on the contract drawings.

The surface shall be finished with a wooden float. A light brooming may be required for a more acceptable finish. Immediately after the finishing operations are completed, the concrete shall be protected and cured in conformance with the requirements specified in Section 2000 *Concrete*.

Riprap shall be placed at the locations and to the dimensions shown on the contract drawings in accordance with the specified requirements.

Riprap shall be graded as necessary to form a dense blanket. The finished surface shall present an even surface conforming to the lines, grades, and sections given. Riprap shall be placed to a minimum depth of eighteen inches (18"). All riprap shall be placed on top of filter fabric.

Riprap shall be placed in such a manner that voids created by larger pieces are filled in by smaller pieces and no voids extend directly through the riprap to the surface below. The riprap shall be placed in rows transversely to the center line of the ditch and in the manner indicated on the drawings. The riprap shall be placed with ends and sides abutting and the joints between rows breaking with the joints in the preceding row.

Riprap shall consist of durable field or quarry stones. Riprap pieces shall range in weight from five (5) pounds to two hundred (200) pounds. Not less than 75 percent (75%) shall be within the range of one hundred (100) pounds to two hundred (200) pounds.

Stone for riprap shall be free from earth, soapstone, shale, shale-like or other easily disintegrated material that will tend to decrease the durability of the material after placement.

When grouted stone riprap is indicated the spaces between stones of grouted riprap shall be filled with grout consisting of one (1) part Portland Cement and three (3) parts of fine aggregate with sufficient water to form a plastic mix. The grout shall be poured and broomed into the spaces until they are completely filled.

- 4008 HEADWALLS, WINGWALLS, ENDWALLS, AND END SECTIONS. Construction will be according to details in the approved plans. Precast concrete or fabricated metal end sections may be used in place of cast-in-place concrete structures with the engineer's approval. Shop drawings will be submitted for precast box culvert pieces.

Materials will be in accordance with Section 2000 *Concrete* and Section 4000 *Storm Sewers* and Standard Details of this Specification. The same type of pipe base metal (steel or

aluminum) shall be used throughout any individual run or installation of pipe or for pipe extension, including end sections.

The end sections for pipe culverts shall be installed in accordance with the requirements specified in Section 6000 of these specifications.

The area excavated for the pipe and headwalls shall be backfilled with suitable material and the material shall be compacted in accordance with the provisions of Section 6000 of these specifications.

4009 **RESTORATION OF SURFACE CONSTRUCTION.** The restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during the progress of the work covered by this section shall conform to the applicable provisions of Section 7000 *Restoration of Surface Construction* of these specifications.

## SECTION 5000--WATER LINES

5001 SCOPE. This section covers all labor and materials for the construction of water lines including all thrust blocks, plugs, valves, pipe encasement, valve boxes, hydrants, connections to existing mains and other appurtenant work.

5002 DUCTILE IRON PIPE. Water lines shall be constructed of ductile iron or polyvinyl chloride (PVC) pipe. Unless otherwise shown on the drawings, joints in ductile iron piping shall be push-on types.

The ductile iron pipe shall conform to ANSI A21.51; ASTM A536, Grade 60-42-10, AWWA C151. The minimum nominal thickness class for ductile iron pipe shall be Class 50 for all mains unless otherwise directed by the city engineer. All water mains shall be polyethylene encased and shall conform to ASTM A674.

The location of all water mains shall be marked on the ground surface during construction. All marks shall remain until the project completion certification has been issued.

5003 PVC PIPE. For water line diameters four (4") inches through twelve (12") inches, PVC shall meet the requirements of ASTM D1784, cell classification 12454-B for PVC compounds, and ANSI/AWWA C900, with the same outside diameter dimensions as ductile iron pipes. The pipe shall be Class 150 unless other designated by the City Engineer.

The location of all water mains shall be marked on the ground surface during construction. All marks shall remain until the project completion certification has been issued.

5004 UNDERGROUND TRACER WIRE. The contractor shall install 12 gauge copper wire along all PVC water lines to facilitate underground location. Connection shall be made to all valve risers as a minimum where no other connection points such as hydrants or flushing assemblies are available. Attachment to valve risers, fire hydrants, or flushing assemblies shall be made using stainless steel band clamps one inch (1") above ground level. Splicing shall be held to a minimum and will not be allowed between valve risers. Split bolt connectors or service connectors shall be used at splice points to maintain electric continuity. Before project acceptance the city will test the electric continuity of all installations at no cost to the contractor.

5005 GATE VALVES. The type, size, and location of valves shall be as indicated on the plans. Except as modified or provided herein, all gate valves shall be 200 psi, resilient seated valves of the waterworks type. All gate valves shall have cast iron bodies or ductile iron and shall have non-rising stems.

Resilient-seated gate valves shall conform to all applicable requirements of AWWA A509 and shall be **American Flow Control Series 2500**, Mueller A2370-20, or Kennedy "Ken-Seal" or Mullen "Waterous" series NRS.

Valve ends shall be of the push-on type conforming to ANSI A21.11 except where flanged ends are required by the drawings and specifications. The end flanges of flanged gate valves shall be ANSI 125 pounds.

All valves shall be provided with stem seals of the O-ring type.

All valves shall be provided with manual operators equipped with a wrench nut conforming to the requirements of AWWA C509.

The direction of rotation of the wrench nut to open the valve shall be to the left (counterclockwise). Each valve body or operator shall have cast thereon the word "*Open*" and an arrow indicating the direction to open.

All exposed bolts below grade shall be stainless steel.

- 5006 BUTTERFLY VALVES. Butterfly valves shall be of the rubber-seat, tight-closing type. Valve discs shall seat at 90° with the pipe axis. Flanged end valves shall be of the short-body type. For buried service, shaft shall be O-ring type.

All butterfly valves and operators shall conform to AWWA C504. Metal mating seat surfaces shall be 18-8 stainless steel or nickel copper alloy. Each valve shall be provided with an operator with a torque rating at least equal to the torques listed in AWWA C504, Table 1.

Butterfly valve shall be Kennedy 50C, American C-150B, Mueller "Line Seal III" or approved equal.

All exposed bolts below grade shall be stainless steel.

- 5007 TAPPING SLEEVES AND VALVES. Tapping sleeves and valves shall be furnished and installed where required by the drawings. The valves shall be 200 psi, resilient-seated, cast or ductile iron body, non-rising stem gate valves conforming with all applicable requirements of AWWA C509 and shall be Mueller "No. A-2307-16" or an approved equal. Each tapping valve shall be provided with a flanged inlet end designed, faced, and drilled for connection to the outlet end of the tapping sleeve. The outlet end of the tapping valve shall be provided with a tapping flange for attachment of a standard drilling machine and also with a mechanical joint-type bell end for connection of the branch main. The tapping sleeve must have pipe tap for pressure testing (water pressure only).

Tapping sleeves shall be of the flanged-outlet type designed for attachment to the flanged inlet end of the tapping valve, and shall be provided with mechanical joint ends at each end of the run and shall be Mueller "No. H-615" for ductile iron pipe, Mueller "No. H-619" or PowerSeal Model 3490 for asbestos-cement pipe, PowerSeal Model 3490 for sandcast iron pipe, JCM model heavy duty stainless steel, with full neoprene gasket or approved equals.

The contractor shall provide 48 hours notice to Public Works prior to tapping the main. A hydrostatic test by the contractor will be required prior to tapping the main. A city representative shall be on site throughout the entire test.

Back-taps shall not be accepted until prior approval is granted by the city engineer. Details shall be provided prior to approval. The pipe plug installed at the completion of the pressure test shall be corrosion resistant to reduce risk of corrosion and/or electrolysis.

5008 VALVE COATINGS. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop-painted for corrosion protection with two coats of asphalt varnish conforming to Federal Specification TT-V-51.

5009 AIR RELEASE AND VACUUM RELIEF VALVES. Combination air release and vacuum relief valve assemblies shall be installed in the locations indicated on the drawings. Each valve assembly shall be installed complete with appurtenant piping and valves as specified or shown.

Combination air release and vacuum relief valves shall be of the integral type with a valve assembly which functions as both an air and vacuum valve and an air release valve. Valves shall have a 2" inlet connection.

The valves shall be designed for a water working pressure of 125 psi, shall have stainless steel floats, and all working parts shall be brass, stainless steel, or other noncorroding materials.

Shutoff valves shall be provided in the piping to each combination air release and vacuum relief valve assembly. Shutoff valves shall be 2" solid wedge gate valves. A precast concrete vault will be positioned at air release location conforming to Standard Detail 50-3.

5010 VALVE BOX AND EXTENSION STEM ASSEMBLY. All buried valves shall be provided with valve boxes. Valve boxes shall be an assembled unit consisting of the valve box, extension stem and a self-centering alignment ring. Valve boxes shall be suitable for the depth of cover required by the drawings. The stem assembly shall be of a telescoping type, to allow for variable adjustment lengths. The stem assembly shall not disengage at the fully extended length. Valve boxes shall not be less than 5 inches (5") in diameter, and shall have a minimum thickness of 3/16-inch at any point. Covers shall have cast thereon the word "Water."

Valve box and extension stem assemblies shall be Ametek with integral key, 2-inch square nut, or equal.

Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves, with the top of the box brought flush with the finished grade. After being placed in proper position, earth backfill shall be filled in around each valve box and thoroughly tamped on each side of the box.

- 5011 **FIRE HYDRANTS.** Fire hydrants shall be Mueller A-423, Waterous "Pacer" 100, **U.S. Pipe Metropolitan 250 Model 94**, American Darling "Quik-Fix" B-84-B, or Kennedy Guardians and shall be furnished with a 6-inch auxiliary gate valve. The fire hydrants shall be pressure rated at 150 psi working pressure and 300 psi test pressure. Hydrants shall be traffic models with breakaway flange or coupling. Fire hydrants shall conform to AWWA C502 with information required by Section 2 as follows:

Type of Shutoff	Compression
Size of Hydrant	5 1/4 inches
Inlet Connection	6 inches
Outlet Nozzles	2-2 1/2 inch hose and 1-4 1/2 inch pumper
Outlet Nozzle Threads	ANSI B-26
Direction to Open	Counterclockwise
Stem Seals	O-ring
Outlet Nozzle Cap Chains	Required
Drain Outlet	Required
Finish Paint	Factory painted above the ground line with yellow enameled paint
Weather Cap on Operating Nut	Required

Hydrants shall be restrained joint and furnished with all joint gaskets required for installation. Hydrants shall be set so that at least the minimum pipe cover is provided for the branch supply line. Each hydrant shall be set on a concrete foundation at least 18" square and 6" thick. Each hydrant shall be suitably anchored.

Hydrant drainage shall be provided by installing around the hydrant, and below the top of the hydrant supply pipe, at least 1/2-cubic yard of 3/4-inch rock.

Fire hydrant installations shall conform to Standard Detail 50-2. All hydrants shall stand plumb. The exact direction the nozzles will be facing shall be determined by the engineer.

The hydrant barrel and shoe shall be secured by means of stainless steel nuts and bolts. All exposed nuts and bolts below the ground level shall be stainless steel. The lower seat shall be threaded into a bronze insert which is threaded into a shoe to form a bronze-to-bronze assembly. Cross arm shall be all bronze.

Immediately before installation of a hydrant, the following operations shall be performed: (a) the hydrant shall be thoroughly inspected; (b) the hydrant interior shall be thoroughly cleaned; (c) the hydrant shall be opened and closed as many times as may be necessary to determine if all parts are in proper working order, with valves seating properly and the drain valve operating freely; and (d) the packing gland checked to determine if the packing is in place and the gland nut properly tightened.

- 5012 **CORPORATION COCKS.** One-inch corporation cocks shall be furnished by the contractor for installation along the pipelines where necessary to vent the lines during filling. The number

and location of the corporation cocks shall be as determined by the contractor. After testing and disinfection of the lines, the corporation cocks shall be removed and a suitable plug installed in each opening. A single hinge brass saddle and a brass plug shall be required.

- 5013 FLUSHING ASSEMBLIES. Flushing assemblies shall be provided at the locations shown on the drawings. Each installation shall be complete with all piping, the gate valve, valve box, covers and lids as required, and shall conform with Standard Detail 50-3. Flushing assemblies will only be allowed on 6-inch mains which will be extended in the future. For all lines greater than 6", a fire hydrant will be required for flushing.
- 5014 MECHANICAL JOINT PIPE AND FITTINGS. Mechanical joint pipe and fittings shall not be used except as approved by the city engineer.
- 5015 PUSH-ON JOINT PIPE AND FITTINGS. Fittings shall be cast from ductile iron in accordance with ANSI/AWWA C153/A21.53, 250 psi pressure rating. Fittings shall be Tyton® Joint, Starr, Union Tite by Tyler, or equal, in accordance with all applicable requirements of ANSI/AWWA C111/A21.11. Design of the joint shall permit deflection of up to 5 degrees after assembly. Gaskets shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable.

In the case of the push-on joint, the gasket seat in the bell shall be wiped clean with a cloth after which the gasket should be sprung into place. Thereafter a thick film of lubricant should be applied to all of the inner surface of the gasket which will come into contact with the entering pipe.

The lubricant and the gaskets shall be as recommended and supplied by the manufacturer of the pipe being used. The lubricant shall be odorless, tasteless, and shall be non-toxic.

The plain end of the pipe shall be wiped clean and a thin film of lubricant shall be applied to the outside of the plain end of the pipe and its beveled edge. The plain end of the pipe should then be placed in approximate alignment with the bell of the pipe to which it is to be joined. The joint can be made up with the entering pipe deflected at an angle, but this angle should not exceed the recommended maximum of the manufacturer. The plain end of the pipe should then be lifted and started into the socket so that it is in contact with the gasket.

The joint is made up by exerting sufficient force on the entering pipe so that its plain end is moved past the gasket (which is thereby compressed) until it makes contact with the base of the socket of the bell. This force can be applied by means of a jack-type tool or backhoe.

Field cut pipe, in the case of the push-on joint, shall be bevel-filed to remove any sharp or rough edges which might otherwise injure the gasket.

- 5016 FLANGED JOINTS. Flanges shall conform to ANSI B16.1, 125 pound or U.S. Pipe "Flange-Tyte." Bolts shall be ASTM A307, chamfered or rounded ends projecting 1/4- to 1/2-inch beyond the outer face of the nut which shall be ASTM A307, hexagonal, ANSI B18.2, heavy

semi-finished pattern. Gaskets shall conform to ASTM D1330, Grade I, red rubber, ring type, 1/8-inch thick or U.S. Pipe "Flange-Tyte", 1/8-inch thick.

The pipe end and flange face shall be machine-finished in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.

When bolting flanged joints, care shall be taken to ensure that there is no restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bell and spigot joints shall not be packed or assembled until all flanged joints affected thereby have been tightened. Bolts shall be tightened gradually and at a uniform rate, so that gasket compression is uniform.

- 5017 RESTRAINED JOINTS. Restrained joints shall be push-on type. Where restrained joints are required or specified, the Mega-Lug, Field Lok® gasket, Fast Grip gasket or approved equal shall be used. Field Lok gaskets shall be used in approved Tyton® Joint, Starr, and Union Tite by Tyler Bells. Fast Grip gaskets shall be used in Fastite Bells. Both assemblies shall be capable of deflection of up to 5 degrees after assembly.

Restrained joint pipe shall be used where shown on the drawings and shall be installed in accordance with the recommendations of the pipe manufacturer. Each restrained joint shall be capable of resisting the thrust of the pressures to be applied.

- 5018 RETAINER GLANDS. Retainer glands shall be manufactured by American "Mechanical Joint Retainer Glands" or Clow "F-1058" and may be used on 12" or smaller pipe for making connection to existing lines provided their installation is in accordance with the recommendations of the pipe manufacturer.

Retainer glands shall not be used on any new or relocated mains where restrained joints are indicated on the drawings.

- 5019 SHOP COATING AND LINING. The interior surfaces of all pipe, regardless of length or type of joint, and the interior surfaces of all 14-inch or larger fittings shall be lined with cement conforming to ANSI A21.4. Flange faces shall be shop-coated with Rust-Oleum "R-9" or Houghton "Rust Veto 344" rust preventative compound. All other surfaces of pipe and fittings shall be coated with a bituminous coating.

- 5020 HANDLING. Pipe, fittings, and accessories shall be handled in a manner that will ensure installation in sound, undamaged condition. Equipment, tools, and methods used in unloading, reloading, hauling, and laying pipe and fittings shall be such that the pipe, pipe coating, and fittings are not damaged. Hooks inserted in ends of pipe shall have broad, well-padded contact surfaces. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.

Pipe and fittings in which the cement lining has been broken or loosened shall be replaced by and at the expense of the contractor. Where the damaged areas are small and readily accessible, the contractor may be permitted to repair the lining.

All pipe coating which has been damaged shall be repaired by the contractor before installing the pipe.

5021 CUTTING PIPE. Cutting shall be done in a neat manner, without damage to the pipe or to the cement lining. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed with a file to remove all roughness and sharp corners.

5022 CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned of foreign matter before being installed and shall be kept clean until the work has been accepted. Before jointing, all joint contact surfaces shall be wire brushed if necessary, wiped clean, and kept clean until jointing is completed.

5023 INSPECTION. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation. Spigot ends shall be examined with particular care since they are vulnerable to damage from handling. All defective pipe and fittings shall be removed from the site of the work.

5024 ALIGNMENT. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the quantities stipulated in Table 1 or Table 2 of AWWA C600.

Either shorter pipe sections or fittings shall be installed where the alignment or grade requires them.

5025 DEAD END LINES. Fire hydrants are required at the termination of all water mains or at locations indicated on the drawings.

5026 CONNECTIONS TO EXISTING WATER MAINS. The contractor shall furnish and install all of the fittings necessary for connections between new water mains and existing water mains. The fittings shall be as indicated on the plans unless otherwise authorized by the city engineer. All connections shall have a valve located at the connection point unless otherwise approved by the city engineer.

When the fittings consist of tapping sleeves and valves, the contractor shall perform the actual tapping operation of the mains under the direction of the Public Works Department. (The Public Works Department will not perform any tapping operations of the water mains unless specified otherwise in the construction drawings).

No connections to existing mains shall be started without prior approval of the Public Works Department, and each connection with an existing main shall be made at a time and under conditions which will least interfere with service to customers affected thereby.

In all cases where it is necessary to take an existing main or service line out of service in order to accomplish the work to be performed, the contractor shall notify the Municipal Services Department at least 24 hours in advance as to the approximate length of time the main or service line will be out of service. The contractor shall also be responsible for notifying all customers to be affected by loss or interruption of service by means of printed information sheets 24 hours in advance of taking the main or service line out of operation.

When the closing of a valve to make the connections affects a customer who cannot be without service, the contractor shall arrange to supply a temporary service and schedule the time which is most convenient to the customer for making the connection to the existing mains.

Facilities shall be provided for proper dewatering and for disposal of all water removed from the dewatered lines and excavations without damage to adjacent property.

Special care shall be taken to prevent contamination when dewatering, cutting into, and making connections with existing pipe. No trench water, mud, or other contaminating substances shall be permitted to get into the lines.

It shall be the responsibility of the contractor to make any and all excavations and backfill as required and furnish all labor, equipment, and material necessary to complete the connection as detailed on the plans.

- 5027 SANITARY SEWER LINE CROSSINGS. Sanitary sewers and water lines shall be constructed a distance of 10 feet apart when they are to be installed parallel to each other. Exceptions to this requirement shall be granted only upon written approval by the Kansas Department of Health and Environment.

Where water lines are to be constructed over and across sanitary sewer lines, at least 2 feet shall be maintained between the bottom of the water pipe and the top of the sewer pipe. At locations where a 2-foot clearance cannot be maintained, the sewer pipe shall be constructed of ductile iron pipe for a distance of at least 10 feet in each direction from the crossing. The ductile iron pipe joints shall be located as far as practical from the pipe crossing.

Where water lines are to be installed under and across sanitary sewer lines, the sanitary sewer lines shall be constructed of ductile iron pipe for a distance of at least 10 feet in each direction from the crossing. The ductile iron pipe joints shall be located as far as practical from the pipe crossing.

- 5028 ROCK EXCAVATION. Where rock is encountered, either dug or shot, the pipe shall be bedded with a minimum of 6 inches of CA-5 rock between the pipe and trench bottom. Granular embedment shall be used at locations directed by the engineer and shall be considered a subsidiary obligation unless specifically provided for as a bid item in the proposal.

- 5029 RESTORATION OF SURFACE CONSTRUCTION. The restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during the progress of the work covered by this section shall conform to the applicable provisions of Section 7000 *Restoration of Surface Construction* of these specifications.
- 5030 END OF CUL-DE-SAC. All cul-de-sacs shall provide a hydrant at the end.
- 5031 BORING WITHOUT CASING PIPE. Borings for watermain construction without casing pipe will be permitted only with the approval of the city engineer.

## SECTION 5100 - TESTING

- 5101 GENERAL. This section covers hydrostatic pressure testing and leakage testing of the pipelines. All pipelines installed under this contract shall be tested as specified herein.

All testing work shall be done in the presence of the engineer or city representative. The contractor shall notify the engineer at least 24 hours in advance of the times and places at which testing work is to be done.

Temporary discharge piping shall be provided for wasting test water at a suitable remote location where such water will drain away from the work. Discharge of test water into sanitary sewers will not be permitted.

- 5102 TESTING EQUIPMENT AND FACILITIES. The contractor shall provide all necessary piping and piping connections between the pipeline to be tested and the nearest available source of water supply, together with test pumping equipment, pressure gauge, and other equipment, materials, and facilities required for the specified tests.

Test pressures shall be applied by means of a force pump of such design and capacity that the required pressure can be applied and maintained without interruption for the duration of each test.

The pressure gauge used shall be tested, accurately calibrated, and acceptable to the engineer.

All pipe, fittings, valves, pipe joints, and other materials which are found to be defective shall be removed immediately and replaced with new and acceptable material, by and at the expense of the contractor.

Materials shall be replaced as necessary and the test shall then be repeated until the line and all parts thereof withstand the test pressure in a satisfactory manner.

- 5103 PRESSURE AND LEAKAGE TEST. The hydrostatic pressure during testing shall be at least 150 psi or 1.5 times the maximum static pressure at the lowest point of the line, whichever is greater. Maximum static pressure, in PSI, shall be calculated by subtracting the lowest USGS elevation of the waterline from the maximum hydraulic grade line (1200' for most areas of Gardner) and then dividing by 2.31 to convert to PSI.

$$\text{Maximum Static Pressure, PSI} = \frac{1200 \text{ ft} - \text{lowest elevation}}{2.31 \text{ ft/PSI}}$$

The selected pressure shall be maintained constant within a maximum variation of plus or minus **5 PSI** during the entire time that line leakage measurements are being made.

Leakage measurements shall not be started until a constant test pressure is established; compression of air trapped in un-vented pipes or fittings will give false leakage readings under

changing pressure conditions. After the selected test pressure is stabilized, the line leakage shall be measured by means of a suitable water meter installed in the pressure supply piping on the line side of the force pump. The water meter shall be furnished and installed by the contractor.

Line leakage shall be the total amount of water introduced into the line as measured by the meter during the leakage test.

Each leakage test shall have a duration of two (2) hours plus whatever additional period is necessary to accurately determine leaking in the opinion of the engineer.

No pipeline or section thereof, will be acceptable if the leakage indicated by the test meter is in excess of that determined by the following formula or as indicated on Standard Detail 51-1.

where  $Q = 0.0075 \text{ DLN}$

Q = Allowable leakage in gallons per hour

D = Nominal diameter of pipe in inches

L = Length of section tested in thousand feet

N = Square root of average test pressure in psi

In the event that the line under test contains pipe of more than one size, the allowable leakage shall be calculated separately for each size and corresponding length of line and then added to obtain the total allowable leakage from the entire line. **Pressure and leak testing shall meet the requirements set forth in the latest edition of KDHE'S Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas.**

5104 **DEFECTS.** It is the intent of these specifications and the contract based thereon that (a) all joints in piping shall be watertight and free from visible leaks during the prescribed leakage test and (b) each and every leak which may be discovered at any time prior to the expiration of two years from and after the date of final acceptance of the work by the owner shall be located and repaired by and at the expense of the contractor, regardless of any amount that the total line leakage rate during the specified leakage test may be below the specified maximum rate.

If the specified leakage test is made after the pipeline has been backfilled and the joints covered, and such test shows a leakage rate in excess of the permissible maximum, the contractor shall make all necessary surveys in connection with the location and repair of leaking joints to the extent required to reduce the total leakage to an acceptable amount. Where evidence of leaking joints does not appear on the ground surface above or near the leaks, the contractor shall prospect the line by sinking a hole, with an auger or otherwise, at the location of each joint and determine any undue saturation of the soil which would indicate a leak at such joint; such prospecting shall be done after pressure has been maintained in the line a sufficient time to provide adequate soil saturation for locating leaks by this method.

Leaks in mechanical joints shall be repaired by dismantling, cleaning, realigning gland and gasket, and re-bolting. Under no circumstances shall gland bolts be tightened beyond the

specified and allowable torque limits in an attempt to reduce or stop leakage from a defective joint or for any other purpose.

- 5105 TAPPING SLEEVES AND VALVES. The tapping sleeve and valve will be tested in place with water for 30 minutes. Test pressure must not exceed rated working pressure (150 psig on 16", 200 psig on 4" through 12"). No leaks will be permitted.

## SECTION 5200 - DISINFECTION

- 5201 SCOPE. This section covers the disinfection of all new water lines, valves, and appurtenant items.
- 5202 GENERAL. Materials, methods, and procedures for disinfection work shall conform to the requirements of AWWA C601, Standard for Disinfecting Water Mains except as modified herein.

All disinfection work shall be acceptable to the Kansas State Board of Health and Environment, and any and all requirements thereof which may be in conflict with any provision of the specification shall govern.

Water in reasonable amounts for proper completion of flushing or disinfection work will be furnished at existing fire hydrants by the owner without charge to the contractor. The contractor shall furnish all necessary pipe, hose, nozzles, and tools and shall perform all necessary labor. Contractor shall make arrangements with the city Utilities Department (who will fix the time, rate, and duration of each withdrawal from the distribution system) as to the amount of water required and the time when the water will be needed. Unnecessary waste of water will not be tolerated. Special hydrant wrenches shall be used for opening and closing fire hydrants. In no case shall pipe wrenches be used for this purpose.

When required by the engineer, the contractor shall submit a detailed outline of the proposed procedure relative to sequence of operations, manner of filling and flushing disinfected lines, and the disposal of wasted water.

**All hydrants and valves involved in the disinfection operation shall be bagged or otherwise marked.**

- 5203 FLUSHING. Immediately prior to disinfection, the main to be disinfected shall be flushed at the maximum velocity which can be developed. The flushing velocity shall be at least 2.5 feet per second. All flushing shall be performed after the hydrostatic test is completed and accepted.

All flushing work shall be done in the presence of the engineer or city representative. The contractor shall notify the engineer at least 24 hours in advance of the times and places at which flushing work is to be done.

- 5204 DISINFECTION. **The pipelines shall be disinfected by the continuous feed method.**

In using the continuous feed method, chlorine feed shall be proportional to the rate of flow into the pipe so that the entering water contains at least 50 mg/l of available chlorine. Chlorine application shall be continuous until the entire pipeline is filled with the chlorine solution. The treated water shall be retained in the pipeline for at least twenty-four (24) hours and the chlorine residual at the end of the period shall be at least 25 mg/l.

**The Disinfections Requirements will meet KDHE's "Policies, General Considerations and Design Requirements for Public Water Supply Systems in Kansas," regarding requirements of disinfection.**

Prior to flushing the line free of chlorine, a test shall be conducted to verify the chlorine residual. Such test shall be performed by the city using the drop dilution method in accordance with AWWA C601. The contractor shall dispose of chlorine and flushing water in a proper manner at no additional cost to the owner.

Prior to flushing the pipe of chlorinated water, the discharge environment shall be inspected. If there is any possibility that the chlorinated discharge will damage the environment, sodium bisulfite or equal neutralizing chemical shall be applied to the water to assure the thorough neutralization of the chlorine residual. This work shall conform to AWWA C651-92, Section 6.

During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. During final flushing operations, valves shall be manipulated in such a manner that the strong chlorine solution in the line being chlorinated will not flow back into the supply line.

- 5205 BACTERIOLOGICAL TESTS. After chlorine solution has been flushed out of the line, and before the line is placed in service, city staff will take samples from each end and quarter points and tested for bacteriologic quality and show the absence of coliform organisms. The samples shall be collected by city staff in accordance with AWWA C601 and delivered to an acceptable independent testing laboratory confirming that there is an absence of coliform organisms. Tests will be made at the expense of the owner.
- 5206 REPETITION. If initial disinfection fails to produce satisfactory bacteriological samples, the disinfection shall be repeated at the expense of the contractor until satisfactory bacteriological samples have been obtained.

## SECTION 5300 - WATER SERVICE RECONNECTIONS

- 5301 GENERAL. The contractor shall supply all materials, labor and equipment necessary for water service reconnection as indicated on the plans. This shall include tapping of the main, boring of road crossings, compaction and resodding of the established lawns.

All other applicable sections of these specifications shall also apply to water service reconnections.

5302 APPROVED MATERIALS FOR RECONNECTION TO DUCTILE IRON PIPE.

- A. Meter Setter--5/8" Ford VH-71-12C with locking stop.
- B. Meter Tile--18" x 30" Sonoloc rigid PVC.
- C. Copper Pipe--Soft "K" copper, 3/4" and larger.
- D. Corporation Stop--Ford F-600; Mueller H-15000 with cc thread.
- E. Meter Tile Cover--Sidener S-18" Meter Box Cover, Traffic Model; Clay & Bailey P-2207 Type T.
- F. Service Saddles--1 1/2" - 2" Mueller (H105); Rockwell 313 or 317, and Ford 101N with stainless steel straps.

5303 APPROVED MATERIALS FOR RECONNECTION TO PVC PIPE.

- A. Meter Setter--5/8" x 3/4" A.Y. McDonald 22-212WD22 33 with locking stop.
- B. Meter Tile--18" x 30" A2000 or equivalent.
- C. Copper Pipe--Soft "K" copper, 3/4" and larger.
- D. Corporation Stop--3/4" cc x 3/4" CTS MACPAC 4701-22 A.Y. McDonald.
- E. Meter Tile Cover--Sidener S-18" Meter Box Cover, Traffic Model; Clay & Bailey P 2210.
- F. Service Saddles--Single Hinge A.Y. McDonald 3895, all brass with cc thread.

- 5304 METER INSTALLATION. All meter setters shall be located at the direction of the Engineering Division.

Water meter pits shall be placed at the property/right-of-way line of the service address. Alternate locations must have prior approval by the city engineer.

All meter setters shall be set in the meter tile so that the face of the meter is at least 16 inches, but not more than 22 inches, below the finished grade.

Meter pits shall not be located in driveways, walkways or cast-in concrete without prior approval from the city engineer. Traffic model rings and lids shall be installed when required for these instances.

All meter tiles shall be set plumb, backfilled and compacted with earth.

Each meter tile shall be centered directly over the meter that it serves.

The top of the tile cover shall be flush with the finished grade.

- 5305 COPPER SERVICE LINES. Copper service lines shall be composed of no more than two (2) separate lengths between the corporation stop and the meter connection.

All connections to the copper tubing shall be made with flared fittings. No field or shop soldered connection will be permitted. All soldered fittings shall be factory soldered using silver solder.

The water service line will be installed in a different ditch from the gas service line. **See Section 3014 for Separation Requirements for water and sewer services.**

All service lines from main to meter must be the same diameter or larger (3/4" minimum) than meter.

- 5306 STREET AND DRIVE CROSSINGS. All street and/or drive crossings shall be made by means of boring, pushing or tunneling. Unless otherwise approved by the engineer, all street borings shall be 48 inches (48") below the finished grade.

No fitting shall be installed under pavement unless approved by the engineer.

- 5307 TAPPING. The contractor shall make all taps on the new water main.

The contractor shall expose the water main immediately prior to tapping.

Excavation and backfilling of the main must be done in the same eight-hour day between 8 A.M. and 5 P.M. It must be filled immediately after the tap is made and inspected.

All barricades and warning devices shall be provided and maintained by the contractor.

- 5308 SALVAGE MATERIALS. All usable salvaged items including fittings, valves, meters, etc., shall be field cleaned and transported by the contractor to the city's designated storage yard and shall remain the property of the owner.

5309 EXCAVATION.

A. Copper Piping.

1. Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated that the rough trench widths of approximately 12 inches (12") maximum width and vertical sidewalls can be obtained at least from an elevation one foot (1') above the top of the installed pipe to the bottom of the trench.
2. The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts or other existing property, utilities or structures above or below ground. In all such locations, hand excavating methods shall be used.
3. Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot (1') above the top of the pipe.
4. Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill cover over the top of the pipe of 42 inches (42"). Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades, but shall be limited to no more than 48 inches (48") of cover. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.

5310 BACKFILL, COMPACTION AND SODDING. Compaction of backfill shall be done immediately after placement of backfill. Under no circumstances shall there be more than eight uncompacted meter locations at one time. Compacted backfill will be required for the full depth of the trench. All sections of this specification concerning backfill, compaction and sodding shall apply to the service line reconnections and replacements.

## SECTION 6000 - EXCAVATION, TRENCHING AND BACKFILLING (Pipeline Construction)

- 6001 SCOPE. This section covers excavation and trenching work and shall include the necessary clearing, grubbing, and preparation of the site; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent property, backfilling, pipe embedment, surfacing and grading, and other appurtenant work.

Attention is directed to the additional requirements set forth in the General Conditions, Supplemental General Conditions or Special Conditions.

- 6002 GENERAL REQUIREMENTS. Excavation work shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards. Excavations shall provide adequate working space and clearances for the work to be performed therein. In no case shall excavation faces be undercut for extended footings.

Subgrade surfaces shall be clean and free of loose material of any kind when concrete is placed thereon.

Excavations for manholes and similar structures constructed of masonry units shall have such horizontal dimensions that not less than six inches (6") clearance is provided for outside plastering.

Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the engineer. No backfill, fill, or embankment materials shall be installed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

- 6003 CLASSIFICATION OF EXCAVATED MATERIALS. When specifically indicated in the proposal and contract, classification of excavated materials will be made as follows:

- a. Rock. Rock excavation will be so classified when sandstone, limestone, blue shale or other similar material is encountered and, in the opinion of the engineer, requires drilling or blasting to remove the material.
- b. Earth. All material not classified as rock.

- 6004 CLEARING. The contractor shall do all clearing necessary for access, stringing of pipeline materials, and construction of the pipeline and appurtenant structures.

At the option of the contractor, all trees, underbrush, stumps, roots, and other combustible materials may be stacked and burned on the site at such locations as permitted by the fire marshall and engineer or removed entirely from the site and disposed of at such locations as determined by the contractor. All materials to be burned shall be piled neatly and, when in suitable condition, shall be burned completely. Piling for burning shall be done in such a manner and in such locations as to cause the least fire risk. All burning shall be so thorough that the materials are completely reduced to ashes. Great care shall be taken to prevent the spread of fire beyond the permanent site limits. Fire guards of adequate width shall be provided wherever there is surface vegetation around any brush pile. No burning of trimmings or brush shall be done when the direction or velocity of the wind is such that there would be any danger of fire being carried into adjacent areas. All governmental requirements relative to burning, fire prevention, and air pollution shall be complied with. See Specification Paragraph 1005a.

- 6005 DEWATERING. The contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the pipe to be installed therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

All excavations for trenches which extend down to or below ground water shall be dewatered by lowering and keeping the ground water level beneath such excavations twelve inches (12") or more below the bottom of the excavation.

Surface water shall be diverted or otherwise prevented from entering excavated areas or trenches to the greatest extent practicable without causing damage to adjacent property.

The contractor will be held responsible for the condition of any pipe or conduit which he may use for drainage purposes, and all such pipes or conduits shall be left clean and free of sediment.

- 6006 SHEETING AND SHORING. Except where banks are cut back on a stable slope, excavation for structures and trenches shall be properly and substantially sheeted, braced, and shored, as necessary, to prevent caving or sliding, to provide protection for workmen and the work, and to provide protection for existing structures and facilities. Sheet piling, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure and shall be rigid, maintaining shape and position under all circumstances.

Trench sheet piling shall not be pulled before backfilling unless the pipe strength is sufficient, in the opinion of the engineer, to carry trench loads based on trench width to the back of sheet piling; nor shall sheet piling be pulled after backfilling. When ordered by the engineer, sheet piling shall be

left permanently in the trench. Payment for such sheeting will be made in accordance with the contract provisions for extra work.

When trench sheeting is left in place, such sheeting shall not be braced against the pipe, but shall be supported in a manner which will preclude concentrated loads or horizontal thrusts on the pipe. Cross braces installed above the pipe to support sheeting may be removed after pipe embedment has been completed.

- 6007 ALIGNMENT AND GRADE. The alignment and grade or elevation of each pipeline shall be maintained as shown on the contract drawings by overhead grade lines parallel to the pipe invert.
- 6008 MINIMUM COVER (Water Mains and Service Lines). Where pipe grades or elevations are not definitely fixed by the contract drawings, trenches shall be excavated to a depth sufficient to provide a minimum depth of backfill covering the top of the pipe of forty-two inches (42"). Greater pipe cover depths may be necessary on vertical curves or to provide necessary clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades. Measurement of pipe cover depth shall be made vertically from the outside top of pipe to finished ground or pavement surface elevation.
- 6009 STABILIZATION. Trench bottoms which become soft, mucky, or otherwise unstable during construction operations shall be stabilized, by and at the expense of the contractor, with one or more layers of crushed rock or other suitable material, where and as necessary to provide a firm and stable base for granular fill pipe foundation material to be placed thereon. Not more than one-half inch (1/2") depth of mud or muck shall be allowed to remain on the stabilized trench bottom when the granular fill pipe foundation material is installed.
- 6010 TRENCH EXCAVATION. The contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work. One block or 400 feet (whichever is the shorter) shall be the maximum length of open trench on any line under construction. The contractor shall backfill all open trench by the end of the day's work, except that which is necessary for inspection or immediate continuation of the following day's work.

Except where tunneling is shown on the drawings, is specified, or is permitted by the engineer, all trench excavations shall be open cut from the surface.

The alignment, depth, and grade of all trenches shall be maintained as shown on the drawings by overhead grade lines parallel to the pipe invert.

All open trenches shall be provided with adequate protective devices.

- 6011 **LIMITING TRENCH WIDTHS.** Trenches shall be excavated to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, and embedment. Ledge rock, boulders, and large stones shall be removed to provide a clearance of six inches (6") below and on each side of all pipes. These distances are minimum clear distances which will be permitted between any part of the pipe and appurtenances being laid on any part, projection, or point of such rock, boulder, or stone.

Cutting trench banks on slopes to reduce earth load to prevent sliding and caving will be permitted only in areas where the increased trench width will not interfere with surface features or encroach on right-of-way limits. Slopes shall not extend lower than one foot (1') above the top of the pipe.

Limiting trench widths below an elevation of one foot (1') above the exterior top of the installed pipe shall be not less than fifteen inches (15") nor more than twenty-four inches (24") greater than the nominal outside diameter of the pipe.

- 6012 **UNAUTHORIZED TRENCH WIDTHS.** Where, for any reason, the width of the lower portion of the trench as excavated at any point exceeds the maximum permitted in Section **6011** of these specifications either special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the engineer, shall be furnished and installed by and at the expense of the contractor.

- 6013 **MECHANICAL EXCAVATION.** The use of mechanical equipment will not be permitted in locations where its operation would cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground.

Mechanical equipment used for trench excavation shall be of a type, design, and construction, and shall be so operated, that the rough trench excavation bottom elevation can be controlled, that uniform trench widths and vertical sidewalls are obtained at least from an elevation one foot (1') above the top of the installed pipe to the bottom of the trench, and that trench alignment is such that pipe when accurately laid to specified alignment will be centered in the trench with adequate clearance between the pipe and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.

If the contractor prefers to undercut the bottom of the trench and bring to grade with 1/2-inch (1/2") crushed rock, he may do so, provided the depth of undercut and backfill with crushed rock shall not exceed four inches (4"). Where crushed rock is used, it shall be placed in the trench, spread uniformly, and graded prior to placing the pipe in the trench.

- 6014 ARTIFICIAL FOUNDATIONS IN TRENCHES. Whenever so ordered by the engineer, the contractor shall excavate to such depth below grade as the engineer may direct and the trench bottom shall be brought to grade with such material as the engineer may order installed. All concrete or other foundations made necessary by unstable soil shall be installed as directed by the engineer. Compensation for extra excavation, concrete, or other foundations, except where provided by contract unit prices, shall be made in accordance with the contract provisions for extra work.
- 6015 PIPE BEDDING. The pipe shall be laid in a flat-bottom trench which has been carefully graded and shaped so that the barrel of the pipe will have bearing for its full length. Blocking of the pipe will not be permitted.

Granular embedment material shall be spread and the surface graded to provide a uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. It will be permissible to slightly disturb the finished subgrade surface by withdrawal of pipe slings or other lifting tackle.

After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.

Embedment material shall be deposited and compacted uniformly and simultaneously on each side of the pipe to prevent lateral displacement.

A. Water Mains: Granular material shall be used for pipe bedding, haunching, and initial backfill. Bell holes shall be excavated in the bottom and sides of the trench to provide ample working space and ensure proper pipe support. No part of the bell shall be in contact with the trench bottom.

Granular material and compacted soil shall conform to the requirements of Standard Detail 60-1.

B. Sanitary Sewers: Granular material shall be used for pipe bedding and haunching. Granular material is also required for the initial backfill on PVC pipe installations. Compacted soil or granular material may be used for initial backfill of DIP and RCP installations. Continuity of embedment material shall be interrupted by compacted soil around each manhole to impede passage of water through the embedment.

Bell holes shall provide adequate clearance for tools and methods used in installing pipe. No part of any bell or coupling shall be in contact with the trench bottom, trench walls or granular embedment at the time the pipe is jointed.

Bedding, haunching and initial backfill materials shall be free of cinders and corrosive materials.

- C. Storm Sewers: Granular material is required for the haunching and initial backfill **of all storm sewer installations.**

If the pipe is located within four feet of the curb and gutter, granular material shall be used for haunching, initial backfill and final backfill for all storm sewer installations.

- 6016 PIPE INSTALLATION. All work shall be in accordance with the following standards or as specified herein. Prior to backfill, all pipe installations shall be inspected by an authorized representative of the city. All pipe not inspected prior to installation shall be uncovered and inspected.

Flexible Thermoplastic Pipe; ASTM D2321

Ductile Iron Water Mains; AWWA C600

Polyvinyl Chloride Water Mains, C900

Reinforced Concrete Pipe

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361, except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Core holes and handling holes in concrete pipe shall be repaired by cementing a properly-shaped concrete plug in place with epoxy cement or by other methods acceptable to the engineer.

Corrugated Steel Pipe

Corrugated metal storm sewer pipe shall be laid with the separate sections joined firmly together, with the outside laps of the circumferential joints pointed upstream, and with the longitudinal laps on the side.

Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer.

Hooks shall not be permitted to contact joint surfaces. Care shall be exercised in handling all pipes to prevent damage to pipe ends. Damaged pipe or pipe damaged in laying shall be replaced by and at the expense of the contractor.

- 6017 TRENCH BACKFILL. All trench backfill above pipe initial backfill shall conform to the following requirements.

Compacted backfill shall be required for the full depth of the trench above the embedment where beneath structures, street, road, or highway right-of-way, driveways, walks, parking areas, and at all locations shown on the plans or as directed by the engineer during the progress of the work.

The top portion of the backfill beneath established sodded areas shall be finished with at least twelve inches (12") of topsoil corresponding to, or better than, that underlying adjoining sodded areas. Topsoil shall be approved by the engineer prior to placement, and unless otherwise directed, shall be material previously excavated and stockpiled for the purpose during excavating and grading operations. Grades on areas to receive topsoil shall be established and maintained as a part of the grading operations. Immediately prior to dumping and spreading topsoil, the surface shall be loosened by discing or scarifying to a depth of two inches (2") to permit bonding of the topsoil to the underlying surface.

Above the initial backfill, job-excavated material may be used for compacted final backfill when the job-excavated material is finely divided and free from debris, organic material, cinders, or other corrosive material, and stones larger than three inches (3") in the greatest dimension. Refer to Standard Detail 60-1 for trenching details for all conduits (including water, storm sewer, sanitary sewer, etc.) in unpaved areas.

For trenching for all conduits under streets (existing and proposed), compacted CA-5 shall be placed from the bottom of the trench to bottom of asphalt pavement. If cover over the pipe or conduit is less than 2 feet from ground surface, CA-5 shall be placed in the bottom of the trench to 6 inches above the top of pipe, overlain by removable flowable fill to the bottom of asphalt pavement from 4' back of curb to 4' back of curb. Refer to Standard Detail 60-3 for details on trenching of conduits under future streets. Flowable fill specifications are provided in Section 6018. For trenching under existing pavement, refer to Section 7000 and Standard Detail 70-1.

Gravel for compacted backfill, other than for street crossings, shall be CA-5 or conform to the following gradation:

Sieve Size	Percent Passing by Weight
1 inch	100
3/4 inch	85 - 100
3/8 inch	50 - 80
No. 4	35 - 60
No. 40	15 - 30
No. 200	5 - 10

The gravel mixture shall contain no clay lumps or organic matter. The fraction passing the No. 4 sieve shall have a liquid limit not greater than 25 and a plasticity index not greater than 5. The backfill shall be compacted by a suitable vibratory roller or platform vibrator to not less than 70 percent (70%) relative density as determined by ASTM D2049.

The method of compaction and the equipment used shall be appropriate for the material to be compacted and shall not transmit damaging shocks to the pipe.

The combination of the thickness of the layer, the method of compaction and the type of compaction equipment used shall be at the discretion of the contractor subject to obtaining the densities as specified above.

Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, organic material, or debris of any kind.

Trench backfill above pipe embedment in locations other than those specified shall be compacted to 90 percent (90%) of maximum density at optimum moisture content as determined by ASTM D698, unless otherwise permitted by the city engineer.

Uncompacted earth backfill material to be placed above embedments shall be free of brush, roots more than two inches (2") in diameter, debris, cinders, or other corrosive material, and junk, but may contain rubble and detritus from rock excavation, stones, and boulders in certain portions of the trench depth. Uncompacted backfill material above embedments may be placed by any method acceptable to the engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on and which will not result in displacement of installed pipe. Uncompacted backfill shall be placed to the extent necessary to prevent excessive future settlement.

Compact masses of stiff clay or other consolidated material more than one (1) cubic foot in volume shall not be permitted to fall more than five feet (5') into the trench unless cushioned by at least two feet (2') of loose backfill above pipe embedment.

No uncompacted trench backfill material containing rocks, or rock excavation detritus, shall be placed in the upper eighteen inches (18") of the trench except with specific permission of the engineer, nor shall any stone larger than eight inches (8") in its greatest dimension be placed within three feet (3') of the top of pipe. Large stones may be placed in the remainder of the trench backfill only if well separated and so arranged that no interference with backfill settlement will result.

6018 FLOWABLE FILL. No material shall be used until it has been checked or tested for compliance with these specifications and approved by the engineer. Representative samples of all materials proposed for use under these specifications shall be submitted to a private laboratory by the contractor, at the contractor's expense, for testing and preparation of trial mixes to determine the mix design. All tests necessary for determining conformance with the requirements specified herein shall be at the contractor's expense.

Laboratory test specimen(s) of the slurry mix, combined in proportions of the job mix design, shall be prepared and tested and shall meet the following requirements:

Removable:

28-day Compressive Strength                      200 psi (1400 kPa) (maximum)

Final Set, ASTM C266                                2 hrs. (maximum)

Mix Design (+/-):

Cement.....144 lbs.

Water.....396 lbs.

Sand.....2698 lbs.

A/E.....13%

At the time of delivery, the slurry shall not be less than 60 degrees F (16 degrees C) nor more than 80 degrees F (27 degrees C).

Slurry shall not be placed on frozen material nor be used to displace water. It shall be placed to fill the voids and to the grades shown on the plans or as directed by the engineer. It shall not be used to displace or replace pavement materials.

- 6019 STRUCTURE BACKFILL. Backfill around structures shall be compacted to the extent necessary to prevent future settlement by tamping or other means acceptable to the engineer.

Material for backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind. No tamped or otherwise mechanically-compacted backfill shall be deposited or compacted in water.

- 6020 DENSITY TESTING. At the option of the engineer, in-place field density testing to determine compliance with specified compaction requirements may be performed using a nuclear moisture-density measuring device. If, as a result of this field testing, the engineer determines that further compaction is required, the contractor shall revise his compaction procedures to obtain the results specified.

- 6021 TUNNEL AND CASING PIPE INSTALLATION. Pipelines shall be constructed in tunnels of the type designated on the drawings, in conformity with the requirements which follow. **Casing pipe will have the strength and integrity equal to or greater than the carrier pipe. Installation will comply with all applicable federal, state, or regulations.** Before starting work on any tunnel, complete details of the method of operation and liner to be used shall be submitted to the engineer for review.

Smooth wall casing pipe shall be welded-steel construction and shall be new material with a minimum yield point of 35,000 psi. Minimum casing wall thickness shall be as indicated in the following table.

Nominal Wall Thickness (Inches)

Diameter of Casing (Inches)	Under Railroads (AREA-Part 5)	All Other Uses
Less than 14	0.188	0.188
14	0.219	0.188
16	0.219	0.250
18	0.250	0.250
20	0.281	0.250
22	0.312	0.250
24	0.344	0.281
26	0.375	0.281
28	0.406	0.312
30	0.406	0.312
32	0.438	0.312
34	0.469	0.312
36	0.469	0.344
38	0.500	0.344
40	0.500	0.344
42	0.500	0.344
44	0.560	0.375
46	0.560	0.375
48	0.560	0.375
50	0.625	0.406
52	0.625	0.406

The conduit shall be installed by jacking into place. Earth displaced by the conduit shall be removed through the interior of the conduit by hand, by auger, or by other acceptable means. Sections of the casing pipe shall be welded together to form a continuous conduit capable of resisting all stresses, including jacking stresses. The casing pipe conduit in its final position shall be straight and true in alignment and grade, as required by the drawings. There shall be no space between the earth and the outside of the casing. Any voids which do occur shall be filled by pressure grouting.

Wood skids shall be provided as shown on the drawings. The wood shall be pressure treated with creosote, pentachlorophenol, or salt-type preservative in accordance with AWWA C2. Cut surfaces shall be given two (2) heavy brush coats of the same preservative. The wood skids shall be securely strapped to the pipe with steel straps.

In sanitary sewer construction, after installation of the pipe in the tunnel, the entire annular space between the pipe and the tunnel walls shall be filled with stabilized sand. Stabilized sand shall be mixed in the proportions of at least 282 pounds of portland cement to each cubic yard

of sand. Cement and sand (fine aggregate) shall be as specified for cast-in-place concrete. Stabilized sand shall be thoroughly mixed in a mechanical mixer. Stabilized sand shall be blown into casing so that all space is filled.

Both ends of casing conduit shall be closed with common brick and mortar.

No interruption of traffic will be permitted at any location where tunnels are required.

6022 DRAINAGE MAINTENANCE. Trenches across roadways, driveways, walks, or other trafficways adjacent to drainage ditches or water courses shall not be backfilled prior to completion of backfilling the trench on the upstream side of the trafficway, to prevent impounding water after the pipe has been laid. Bridges and other temporary structures required to maintain traffic across such unfilled trenches shall be constructed and maintained by the contractor. Backfilling shall be done so that water will not accumulate in unfilled or partially-filled trenches. All material deposited in roadway ditches or other water courses crossed by the line of trench shall be removed immediately after backfilling is completed and the original section, grades, and contours of ditches or water courses shall be restored. Surface drainage shall not be obstructed longer than necessary.

6023 PROTECTION OF TRENCH BACKFILL IN DRAINAGE COURSES. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. When the grade of the ditch exceeds 1 percent (1%), ditch checks shall be installed. Unless otherwise shown on the drawings or directed by the engineer, ditch checks shall be concrete. Ditch checks shall extend not less than two feet (2') below the original ditch or water course bottom for the full bottom width and at least eighteen inches (18") into the side slopes and shall be at least twelve inches (12") thick.

6024 DISPOSAL OF EXCESS EXCAVATED MATERIALS. Except as otherwise permitted, all excess excavated materials shall be disposed of away from the site of work.

Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench backfill, junk, and debris encountered in excavation work and other similar waste materials shall be disposed of away from the site of the work.

Excess earth from excavations located in unimproved property shall be distributed directly over the pipe trench and within the pipeline right-of-way to a maximum depth of six inches (6") above the original ground surface elevation at and across the trench and sloping uniformly. Drag with blade machine, or other suitable tool to a smooth, uniform surface without obstructing drainage at any point. Wasting of excess excavated material in the above manner will not be permitted where the line of trench crosses or is within a railroad, public road, or highway right-of-way. The disposal of waste and excess excavated materials, including hauling, handling, grading, and surfacing shall be a subsidiary obligation of the contractor and no separate payment will be made therefore.

6025 SETTLEMENT. The contractor shall be responsible for all settlement of backfill, fills and embankments which may occur within two (2) years of time after final acceptance of the contract under which the work was performed.

A suitable maintenance bond in an amount approved by the city engineer shall be furnished to the city of Gardner by the contractor guaranteeing the maintenance of the construction under which the contract was performed. Said bond shall remain in effect for the period mentioned above from the date of completion and acceptance of the work by the city.

The contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within thirty (30) days after notice from the engineer.

## SECTION 6100 - BLASTING

### 6101 GENERAL.

- A. Blasting will be permitted. Blasting shall be done only by people experienced in the handling of explosives, and in accordance with the recommendations of the AGC Manual of Accident Prevention in Construction and OSHA regulations. In locations where flying rock may be present, additional overburden shall be ready for use and/or in place before denotation. All trenching operations utilizing explosives shall be suitably backfilled to prevent any fly rock endangerment to persons or property. The use of these procedures does not relieve the contractor of responsibility for damage to life and property but acts only as an added assurance to the owner that damage will not occur.
- B. The Gardner Public Safety Department will be known as the "authority having jurisdiction" regarding the storage, handling, use and control of explosives used in construction projects. All permits for this use will be issued by the Public Safety Department. Control of the right-of-way remains with the Engineering Division.

Requirements of the International Fire Code regarding explosives and blasting agents shall be considered part of these specifications. All explosives and related material shall be in conformity with the requirements of the authority having jurisdiction, and the specifications contained herewith, whichever is more stringent. Blasting will not be permitted within eighty feet (80') of any building structure.

All blasting operations shall be conducted under the direction of a Kansas certified blaster. Certificates of blaster certification shall be carried by blasters or shall be on file at the Public Safety Department during blasting operations. A blaster and at least one other person shall be present at the firing of a blast. Persons responsible for blasting operations at a blasting site shall, as a minimum, conform to the criteria as outlined.

The contractor shall be responsible for all damage caused by his blasting operations and shall be responsible for responding to all complaints. Suitable methods shall be employed to confine all materials lifted by blasting within the limits of the excavation or trench. All rock which cannot be handled and compacted as earth shall be kept separate from other excavated materials and shall not be mixed with backfill or embankment materials except as specified or directed

All blasting by the contractor and his subcontractors shall be in conformity with the requirements having jurisdiction over the right-of-way, or the specifications contained herewith, under the International Fire Code and Public Safety Department, whichever is more stringent.

The blast design shall be submitted to the Public Safety Department for review prior to any blasting operations. The blast design shall contain sketches of the drill patterns, delay periods, and decking and shall indicate the type and amount of explosives to be used, critical dimensions, and the location and general description of structures to be protected, as well as a discussion of design factors to be used, which protect the public and meet the applicable airblast and ground vibration standards. The blast design shall be prepared and signed by a certified blaster. The Public Safety Department shall may request changes to the design submitted.

- 6102 PREBLASTING SURVEY. At least 30 days before initiation of blasting, the surveyor shall notify, in writing, all residents or owners of dwellings or other structures located within 600 feet of the blasting area of the intent to conduct a preblasting survey. The Pubic Safety Department may identify alternate preblast survey distances.

The surveyor shall promptly conduct a preblasting survey of the dwellings or structures and promptly prepare a written report of the survey. An updated survey of any additions, modifications, or renovations shall be performed by the surveyor if requested by the contractor or Pubic Safety Department.

The surveyor shall determine the condition of the dwelling or structure and shall document any existing damage and other physical factors that could reasonably be affected by the blasting. The surveyor shall examine the interior as well as the exterior structure and shall document any damage by means of photographic or video cassette methods. Structures such as pipelines, cables, transmission lines, cisterns, wells, and other water systems warrant special attention; however, the assessment of these structures may be limited to surface conditions and other readily available data. The interior of the existing sanitary sewer shall be surveyed by means of a permanently recorded closed circuit video camera prior to blasting operations and after blasting has been concluded in the area of the existing sewer.

The written report of the survey shall be signed by the person who conducted the survey. Copies of the report shall be promptly provided to the contractor and to the Pubic Safety Department. All surveys shall be completed by the surveyor before the initiation of blasting. All surveys shall be conducted by a disinterested third party, regularly engaged in performing preblast surveys.

The contractor shall submit with the bid, a detailed preblast survey method to be reviewed by the Pubic Safety Department. The preblast survey shall not commence until the survey method has been reviewed by the Pubic Safety Department for completeness.

- 6103 PUBLIC NOTIFICATION. Before blasting is started, the contractor shall inform all residents within a radius of 1500 feet of the blasting location by means of printed information sheets.
- 6104 WARNING SYSTEM. The contractor shall provide suitable warning by siren or whistle prior to all blasts.

- 6105 OVER-BLASTING. The requirements presented herein shall not relieve the contractor from responsibility to avoid disturbing earth or rock beyond indicated and specified lines and levels.
- 6106 NOTIFICATION. The contractor shall notify the owner of all gas, water, and petroleum pipe lines in any area where blasting will be utilized. A representative of the pipeline owner shall be allowed to be present to observe preparations and blasting.
- 6107 TECHNICAL ASSISTANCE. When necessary, the Public Safety Department can render technical assistance in controlling ground vibration and fly rock at the request of the blaster and/or the Engineering Division.
- 6108 BLASTING SCHEDULE. The contractor shall conduct blasting operations at times approved by the Public Safety Department and engineer, and announced in the blasting schedule.

All blasting shall be conducted between 8:30 a.m. and 4:30 p.m. The Public Safety Department or engineer may specify more restrictive time periods for blasting.

- 6109 BLASTING SIGNS, WARNINGS, AND ACCESS CONTROL. Blasting signs shall meet the specifications of this section. The contractor shall:
- A. Conspicuously place signs reading *Blasting Area* along the edge of any blasting area that comes within 100 feet of any public road right-of-way, and at the point where any other road provides access to the blasting area; also, conspicuously place signs reading *Blasting Area - Turn Off Two-Way Radios* along the edge of any blasting area that comes within 500 feet of any public road right-of-way and 1000 feet on either end of the blasting area; and
  - B. At all entrances to the permit area from public roads or highways, place conspicuous signs which state *Warning! Explosives In Use*, which clearly list and describe the meaning of the audible blast warning and all-clear signals that are in use, and which explain the marking of blasting areas and charged holes awaiting firing within the permit area.

Warnings and all-clear signals of different character or pattern that are audible within a range of 1000 feet from the point of the blast shall be given. Each person within the permit area and each person who resides or regularly works within 1000 feet of the permit area shall be notified of the meaning of the signals.

Access within the blasting area shall be controlled to prevent presence of livestock or unauthorized persons during blasting and until an authorized representative of the contractor has reasonably determined that no unusual hazards, such as imminent slides or un-detonated charges, exist; and access to and travel within the blasting area can be safely resumed.

6110 CONTROL OF ADVERSE EFFECTS. Blasting shall be conducted to prevent injury to persons, damage to public or private property outside the permit area, adverse impacts on any underground mine, and change in the course, channel, or availability of surface or ground water outside the permit area.

A. Airblast. Airblast shall not exceed the maximum limits listed on the next page at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area, except as provided in this section.

Lower frequency limit of measuring system, in Hz (+3 dB)	Maximum level, in dB
0.1 Hz or lower--flat response <sup>1</sup>	134 peak.
2 Hz or lower--flat response	133 peak.
6 Hz or lower--flat response <sup>1</sup>	129 peak.
C-weighted--slow response	105 peak dBC.

<sup>1</sup> Only when approved by the Pubic Safety Department.

If necessary to prevent damage, the Pubic Safety Department or engineer can specify lower maximum allowable airblast levels than those of listed in this section for use in the vicinity of a specific blasting operation.

The contractor shall conduct periodic monitoring to ensure compliance with the airblast standards. The measuring systems shall have an upper-end flat frequency response of at least 200 Hz.

B. Ground Vibration. The maximum ground vibration for protected structures listed in this section shall be established in accordance with either the maximum peak-particle-velocity limits, the scaled-distance equation, the blasting level chart , or by the Pubic Safety Department. All structures in the vicinity of the blasting area, such as water towers, pipelines and other utilities, tunnels, dams, impoundments, and underground mines, shall be protected from damage by establishment of a maximum allowable limit on the ground vibration, 1.0 inches per second, the Pubic Safety Department may specify a more restrictive limit in the interest of the public safety, or the Pubic Safety Department may approve a higher limit if justified by the contractor.

The maximum ground vibration shall not exceed the following limits at the location of any dwelling, public building, school, church, or community or institutional building outside the permit area.

	MAXIMUM	
	ALLOWABLE	SCALED PEAK
Distance (D) from the blasting site in feet.	Particle velocity (Vmax) for ground vibration in inches/second <sup>1</sup>	Factor to be applied without seismic monitoring <sup>2</sup>
0 to 300	1.00	50
301 to 5,000	1.00	55
5,001 and beyond	0.75	6

<sup>1</sup> Ground vibration shall be measured as the particle velocity. Particle velocity shall be recored in three mutually perpendicular directions. The maximum allowable peak particle velocity shall apply to each of the three measurements.

<sup>2</sup>Applicable to the scaled-distance equation.

A seismographic record shall be provided for each blast.

A contractor may use the scaled-distance equation,  $W=(D/D_s)$ , to determine the allowable charge weight of explosives to be detonated in any 8-millisecond period, without seismic monitoring; where W=the maximum weight of explosives, in pounds; D=the distance, in feet, from the blasting site to the nearest protected structure; and D<sub>s</sub>=the scaled-distance factor, which may initially be approved by the engineer using the values for scaled-distance factor listed.

The contractor may use the ground-vibration limits in Figure 1 this section to determine the maximum allowable ground vibration.



FIGURE 1

If the Figure 1 limits are used, a seismographic record including both particle velocity and vibration-frequency levels shall be provided for each blast. The method for the analysis of the predominant frequency contained in the blasting records shall be approved by the Public Safety Department before application of this alternative blasting criterion.

The maximum allowable ground vibration can be reduced by the Public Safety Department beyond the limits otherwise provided by this section, if determined necessary to provide damage protection.

The contractor shall conduct seismic monitoring of all blasts.

6111 RECORDS OF BLASTING OPERATIONS. The contractor shall retain a record of all blasts for at least three (3) years. Upon request, copies of these records shall be made available to the engineer and to the public for inspection. Such records shall contain the following data:

- A. Name of the contractor conducting the blast.
- B. Location, date, and time of the blast.
- C. Name, signature, and certification number of the blaster conducting the blast.
- D. Identification, direction, and distance, in feet, from the nearest blast hole to the nearest dwelling, public building, school, church, community or institutional building outside the permit area, except those described herein.
- E. Whether conditions, including those which may cause possible adverse blasting effects.
- F. Type of material blasted.
- G. Sketches of the blast pattern including number of holes, burden, spacing, decks, and delay pattern.
- H. Diameter and depth of holes.
- I. Types of explosives used.
- J. Total weight of explosives used per hole.
- K. The maximum weight of explosives detonated in an 8-millisecond period.
- L. Initiation system.
- M. Type and length of stemming.
- N. Mats or other protections used.
- O. Seismographic and airblast records, shall include:
  - 1. Type of instrument, sensitivity, and calibration signal or certification of annual calibration;
  - 2. Exact location of instrument and the date, time and distance from the blast;
  - 3. Name of the person and firm taking the reading;
  - 4. Name of the person and firm analyzing the seismographic record; and
  - 5. The vibration and/or airblast level recorded.

6112 BLASTER. The blaster shall be trained and be knowledgeable in the applications of all section.

The blaster shall be responsible for:

- A. Explosives, including
  - 1. Selection of the type of explosive to be used;
  - 2. Determination of the properties of explosives which will produce desired results at an acceptable level of risk; and
  - 3. Handling, transportation, and storage;
- B. Blast designs, including
  - 1. Geologic and topographic considerations;
  - 2. Design of a blast hole, with critical dimensions;
  - 3. Pattern design, field layout, and timing of blast holes; and
  - 4. Field applications;
- C. Loading blastholes, including priming and boosting;

- D. Initiation systems and blasting machines;
- E. Blasting vibrations, airblast, and flyrock, including
  - 1. Monitoring techniques, and
  - 2. Methods to control adverse effects;
- F. Secondary blasting applications;
- G. Current federal and state rules applicable to the use of explosives;
- H. Blast records;
- I. Schedules;
- J. Preblasting surveys, including
  - 1. Availability
  - 2. Coverage, and
  - 3. Use of in blast design;
- K. Blast-plan requirements
- L. Certification and training;
- M. Signs, warning signals, and site control
- N. Unpredictable hazards, including
  - 1. Lightning,
  - 2. Stray currents,
  - 3. Radio waves, and
  - 4. Misfires

The blaster shall be licensed by the appropriate licensing authority. The blaster shall be responsible for obtaining all necessary permits required for blasting operations.

## SECTION 7000 - RESTORATION OF SURFACE CONSTRUCTION

- 7001 **SCOPE.** This section covers restoration of concrete and asphalt pavement, gravel surfacing, walks, drives, curbs, and other surface construction removed or damaged during construction.
- 7002 **GENERAL.** All pavement or other surface construction which is removed or damaged during the progress of the work shall be restored to its original or better condition by the contractor. All restoration work shall be subject to acceptance by the engineer and the owner or the agency having jurisdiction thereof. All materials used for restoration work shall be new.
- 7003 **REFERENCE STANDARD.** Materials and construction methods, as referred to herein, shall conform to the Standard Specifications for State Road and Bridge Construction, Kansas Department of Transportation (current edition), and to applicable sections of these technical specifications.
- 7004 **PAVEMENT REPLACEMENT.** The replacement of all street surfacing shall be in accordance with the pavement replacement detail shown on Standard Detail 70-1. The replacement asphalt pavement shall be composed of an asphaltic concrete base course (6" for residential streets, 8" for collectors, and 10" for arterials) and an asphaltic concrete overlay at least two inches (2") thick. Flowable fill shall be installed below the asphaltic base to the top of pipe underlain by CA-5 backfill around the pipe. Materials and workmanship shall conform to the following:

Asphalt Aggregate	Type BM-2 and Type BM-2B, Section 1103, "Kansas Highway Specification" or as directed by the city engineer
Flowable Fill	Removal flowable fill (mix specified in Section 6018)
Trench Backfill	Graded gravel, Type CA-5, Section 1102, "Kansas Highway Specification"

All temporary surfacing placed on public streets will consist of cold mix asphalt at a minimum. Maintenance of the temporary patch is the responsibility of the contractor and is considered a subsidiary item unless noted otherwise in the contract documents.

All drives, parking areas, and other pavement or asphalt surfaces which are removed or damaged shall be replaced to at least their original thickness. Materials used shall be new and shall match the existing surfacing as closely as possible in type, kind and quality, with the exception of drive approaches which shall be constructed of 4000 psi portland concrete as per Sections 2000 and 2100.

- 7005 CONCRETE WALKS. Concrete walks removed in connection with, or damaged as a result of, construction operations shall be replaced with new construction. Such walks shall be constructed of concrete on a thoroughly compacted subgrade, shall have a vertical thickness at least as thick as the existing walks, but not less than four inches (4") thick, shall be constructed with expansion joints spaced not exceeding fifty feet (50') apart, and shall be sloped for drainage at right angles to the longitudinal centerline in the amount of approximately one-fourth inch (1/4") per foot of walk width. Temporary sidewalks may be required as directed by the city engineer.

Concrete materials and workmanship shall conform to the applicable requirements of Section 2000 *Concrete* of these specifications.

Surface finish of concrete walks replaced shall conform to, and shall match as closely as possible, that of existing concrete walk surfaces.

- 7006 CONCRETE CURBS AND GUTTERS. Concrete curbs and gutters which have been removed or damaged by reason of construction operations or any other cause shall be replaced with new concrete construction. New curb and gutter sections shall be as designated on the drawings and detailed on Standard Details 21-1 and 21-2.

Concrete materials and workmanship shall conform to the applicable requirements of Section 2100 *Concrete Curb, Curb and Gutters, Sidewalk, and Driveway Entrances* of these specifications.

Construction and expansion joints, dimensions, elevations and surface finish of curb and gutter replacements shall conform to, and shall match as closely as possible, that of adjacent existing concrete curbs and gutters.

- 7007 GRAVEL SURFACING. Existing gravel drives, parking and surfacing which is removed or damaged during the progress of the work shall be replaced with an aggregate surfacing at least as thick as that removed, but in no case less than four inches (4").

New aggregate surfacing shall match existing surfacing as nearly as possible in size, gradation, color, and compaction.

- 7008 MISCELLANEOUS REPAIR WORK. All existing items and construction, whether or not indicated by the drawings but which are removed or damaged as a result of construction operations under this contract, shall be repaired or replaced unless otherwise required by the drawings.

Repair or replacement shall be with materials similar to those existing, and shall in each case restore the item to its original or better condition as acceptable to the engineer and the owner thereof.

## SECTION 7100 - CHAIN LINK FENCING

7101 **SCOPE.** This specification covers chain link fencing and gates.

7102 **FENCE TYPE.** Fencing shall conform to the alignment and details shown on the drawings and shall consist of galvanized or aluminum-coated steel fabric, steel posts, top rail, and bottom rail or tension wire. Posts shall be set in concrete.

7103 **MATERIALS.** All steel or malleable iron parts and accessories shall be hot-dip galvanized or aluminum coated after fabrication.

Fabric	9 gauge, 2-inch mesh; galvanized ASTM A392, Class II or aluminum-coated ASTM A491, Class II.
Posts	Steel H-Section, 0.35 percent carbon; steel pipe, ASTM A120, standard weight (Schedule 40); or steel hollow structural tubing, ASTM A500 or A501.
Line Posts	
For 6-foot Fencing	H-Section 4.10 pounds per foot; 2 3/8 inch OD pipe, 3.65 pounds per foot; or 2 inch square, 3.85 pounds per foot.
For 42-inch Fencing	H-Section, 2.70 pounds per foot; or 1 7/8 inch OD pipe, 2.72 pounds per foot.
Terminal Posts	End, corner, and pull posts.
For 6-foot Fencing	2 7/8 inch OD pipe, 5.79 pounds per foot; or 2 1/2 inch square, 5.59 pounds per foot.
For 42-inch Fencing	2 3/8 inch OD pipe, 3.65 pounds per foot; or 2 inch square, 3.85 pounds per foot.
Gate Posts	Gate or leaf 6 foot or less, 2 7/8 inch OD pipe, 5.79 pounds per foot; or 2 1/2 inch square, 5.59 pounds per foot; gate or leaf over 6 foot, 4 inch OD pipe, 9.10 pounds per foot; or 3 inch square, 9.10 pounds per foot.
Top Rail	1 5/8 inch OD steel tubing, 1.40 pounds per foot.
Rail Couplings	Sleeve type, 6 inches long.
Post Tops (when barbed wires are required at the top of the fence)	Pressed steel, malleable iron, with pressed steel extension arm, or hole for top rail, designed to prevent entry of moisture into tubular posts.
Posts Tops	Pressed steel, malleable iron, or cast aluminum; designed to prevent entry of moisture into tubular posts.

Barbed Wire	Galvanized, ASTM A121, Class 2 or aluminum coated ASTM A585, Class II; two 12 1/2 gauge steel wires with 4 point barbs.
Stretcher Bars	Steel, 3/16 inch by 3/4 inch, or equivalent area.
Fabric Ties	Aluminum bands or wires.
Gate Frames	Steel tubing, 1 7/8 inch OD, 2.09 pounds per foot; or 2 inch square, 2.10 pounds per foot.
Tension Wire	Galvanized or aluminum coated coil spring wire, 7 gauge.
Handrail-Setting Cement	Hallemite "Por-Rok Cement".

- 7104 GATES. Gates shall be swing type, hinged to swing 90° from closed to open, complete with frames, latches, stops, keepers, hinges, and fabric. Gate leaves shall have intermediate members and diagonal truss rods as required for rigid construction. Joints between frame members shall be made by welding or by means of heavy fittings, and shall be rigid and water tight. Gate fabric shall be same as fence fabric and shall be attached to frame ends by stretcher bars, bolt hooks, or other mechanical means.

Hinges shall be heavy pattern with large bearing surfaces and shall not twist or turn under the action of the gate. Latches shall be plunger bar type, full gate height, and arranged to engage the gate stop, except single gates less than ten feet (10') wide may be provided with a forked latch. Latches shall be arranged for padlocking with the padlock accessible from both sides of the gate. Stops shall consist of a roadway plate with anchor set in concrete and arranged to engage the plunger. Keepers shall consist of mechanical devices for securing and supporting the free end of gates when in the full-open position.

Gates shall be installed so that they cannot be removed without disassembly of the hardware. Hardware attachment bolts shall be peened so that removal will be difficult.

- 7105 FENCE CONSTRUCTION. The installed fence shall conform to the alignment and finish grade indicated. All posts shall be plumb and unless otherwise shown or required shall be spaced ten feet (10') apart for 6-foot fencing and six feet (6') apart for 42-inch fencing. Where necessary, the fence grade shall be adjusted to fit the ground contour by slipping the fence fabric links. Ground surface irregularities shall be graded as required to maintain not more than a two inch (2") clearance below the bottom of the fence fabric.

Where posts are set in earth, concrete foundations thirty-six inches (36") deep shall be provided. If bedrock is encountered, post excavation shall be continued to the thirty-six inch (36") depth or eighteen inches (18") into the rock, whichever is less. Concrete foundations shall be circular in horizontal section, not less than ten inches (10") in diameter for line posts, and with a diameter not less than the post OD plus nine inches (9") for terminal and gate posts,

except that foundations in bedrock shall be a minimum of six inches (6") larger than the outside dimension of the post. Foundations shall extend above the ground surface and shall be crowned approximately one inch (1"). Concrete for foundations shall conform to the requirements of Section 2000 *Concrete*. Each foundation shall be cured for at least seventy-two (72) hours before further work is done on the post.

Top rails and bottom tension wires shall be installed before the fabric. Top rails shall be furnished in at least eighteen foot (18') lengths and shall be securely connected to gate and terminal posts. Tension wires shall be installed approximately six inches (6") above grade and shall be attached to each post and securely anchored at terminal and gate posts. Straight runs between braced posts shall not exceed 1500 feet. A terminal post shall be provided at each change in slope.

Fabric shall be attached to the top rail, bottom rail, and bottom tension wire at twenty-four inch (24") centers and to the line posts at fifteen inch (15") centers. Barbed wire shall be fastened to each extension arm by internal clips or external fabric ties. Each stretcher bar shall be threaded through the fabric and anchored to the post at fifteen inch (15") center by positive mechanical means.

Each gate and terminal post shall be braced by horizontal pipe brace and an adjustable truss extending to an adjacent line post. Corner posts shall be braced in both directions.

Fabrics shall be stretched taut and anchored so that a pull of 150 pounds at the middle of a panel will not lift the bottom of the fabric more than six inches (6").

## SECTION 7200 - SEEDING AND SODDING

7201 SCOPE. This section covers the furnishings of all labor, equipment, tools and materials, and the performance of all work for seeding or sodding as designated on the contract drawings.

7202 GENERAL. The seeding work shall consist of furnishing and drilling in or sowing seed by an experienced seeding contractor having approved equipment manufactured expressly for the purpose, such as a seed drill with fertilizer attachment, mulch chopper and blower for the application of hay or straw mulch, mulch puncher or straight serrated disc for punching mulch into soil and a cultipacker that may be used for final compaction.

For public improvement projects seeding shall be required at all locations shown on the plans and for all grass covered areas that are disturbed by construction operations, either by grading, parking of equipment, temporary roads, or any other operation that has destroyed the existing grasses of the original site, and that is not designated on the drawings to be replaced with sod.

For all other types of construction, including that work done under a work within right-of-way permit, sod shall be required where areas are disturbed by construction within the right-of-way in established yards or as directed by the city engineer. In established yards, the new sod shall match the existing sod.

Sod work shall be performed by an experienced sod-laying contractor.

7203 MATERIAL. The sod shall be densely-rooted Kentucky Bluegrass. The sod shall contain a growth of not more than 10 percent (10%) of **other** grasses and clovers, shall be free from all prohibited and noxious weeds, and shall be three-fourths (3/4") to one and one-fourth inch (1-1/4"); each strip containing at least one (1) square yard. Sod shall be cut in strips not less than twelve inches (12") wide.

Commercial fertilizer for seeded or sodded areas shall contain 12 percent (12% by weight) nitrogen, 12 percent (12% by weight) phosphoric acid, and 12 percent (12% by weight) potash. It shall be uniform in composition, free flowing, and delivered to the site in standard size bags, showing weight, analysis, and name of manufacturer. It shall be stored until use in a weatherproof storage place in such a manner that it will be kept dry and its effectiveness will not be impaired.

Seeds for cover crops shall be the kind and mixture of seeds specified herein. Seeds shall be free of prohibited weed seeds and shall not have more than 1 percent (1%) of noxious weed seeds. Seeds shall be delivered to the site in convenient containers, each fully labeled, bearing the name, or trade mark and a warranty of the producer and a certificate of the percentage of the purity and germination of each kind of seed specified. The tags shall be made available to the engineer for filing.

The following formula shall be used to determine the amount of commercial seed required to provide for each kind of seed the specified quantities of pure live seeds.

$$\text{Pounds of Commercial Seed Required} = \frac{10,000 \times \text{Rate of Pure Live Seeds (lbs/acre)}}{\text{Purity \%} \times \text{Germination \%}}$$

Where seeding is required in areas of established yards, shoulders and slopes in street right-of-way, and any other areas where a high-quality seeding is deemed necessary, the seed mixture will be as follows:

	MINIMUM PURE	RATE OF PURE LIVE SEED
KIND OF SEED	LIVE SEED (%)	POUNDS/ACRE
Perennial Rye (Derby or equivalent)	80%	65
Turf-type Tall Fescue (Rebel II or equivalent)	80%	175
Annual Rye	85%	10
		Total 250 lbs/Acre

Where seeding is required in vegetation-covered medians, the seed mixture will be as follows:

	MINIMUM PURE	RATE OF PURE LIVE SEED
KIND OF SEED	LIVE SEED (%)	POUNDS/ACRE
Buffalograss	85%	90
Annual Rye	85%	110
		Total 200 lbs/Acre

Where seeding is required in areas off street right-of-way that are not maintained periodically, the seed mixture will be as follows:

	MINIMUM PURE	RATE OF PURE LIVE SEED
KIND OF SEED	LIVE SEED (%)	POUNDS/ACRE
Alta Fescue or Kentucky 31 Fescue (Festuca Elatior) Var. Arundinacea)	75%	90 lbs.
Rye Grass (Lolium Perenne or L. Multiflorum)	80	50
		Total 140 lbs./Acre

Mulch for application to seedbed areas shall include wheat straw, oat straw, smooth brome grass hay, Sudan grass hay or prairie hay. Prairie hay shall consist chiefly of bluestem grasses, switchgrass, Indian grass and other desirable native perennial grasses. Mulch shall be free of prohibited and noxious weed seeds.

7204 TIME OF SEEDING OR SODDING. Seeding and fertilizing shall be performed between August 15 and October 15 for fall planting and between February 15 and April 30 for spring planting, unless otherwise acceptable to the engineer. Seeding and fertilizing shall not be done during periods of such severe drought, high winds, or excessive moisture, as determined by the engineer, that satisfactory results are not likely to be obtained.

Sod shall not be placed between June 15 and September 15 or on frozen ground nor during the period from October 15 to March 15, unless authorized by the engineer.

Any seeding or sodding to be performed during periods other than those previously designated will require a written request to extend the permissible period for performing such work. Said request shall explain the reason for the variance and shall include a guarantee (by the general contractor) of satisfactory results by the end of the first four (4) weeks of the following growing season as previously defined, or the necessary re-seeding or re-sodding work performed at that time. The request shall be initiated by the general contractor and directed to the city engineer for consideration for approval.

7205 APPLICATION OF FERTILIZER. Before tilling of the soil for seeded areas, the commercial fertilizer of the type specified shall be uniformly distributed over the entire site at the rate of six hundred (600) pounds per acre, and incorporated into the soil to a depth of at least two inches (2") by discing or harrowing methods or with a fertilizer drill. The fertilizer may be applied with the seeding operation only if a seed drill with a fertilizer attachment is used. (The above fertilizer rate is equivalent to seven [7] pounds to five hundred [500] square feet).

7206 PREPARATION OF SOD BED. The sod bed shall have a uniform surface free from washes and depressions and shall conform to the finished grade profile or cross section shown on the plans. The soil, except where fresh top soil has just been applied and compacted, shall be thoroughly tilled to a depth of two inches (2"). Freshly-graded areas, which have set long enough to become dry and crusted over shall be tilled as specified above, preparatory to placing the sod. **The contractor must have the prepared sod-bed inspected and approved by the city prior to any sod being placed. Any sod placed prior to the sod-bed being inspected and approved by the city is subject to being removed, the deficiencies corrected, and the sod replaced at the contractors expense.**

Sod placed next to existing grassy areas, curbs, sidewalks or like boundaries shall be cut-in to match like grades.

7207 PLACEMENT OF SOD. Sod shall be transplanted within twenty-four (24) hours from the time it is harvested. All sod in stacks shall be kept moist and protected from exposure to the sun and from freezing.

The fertilized sod beds shall be in a firm but not too compacted condition with relatively fine texture at the time of sodding. Sod shall be moist when it is placed. The use of dry sod will not be permitted. Sod strips shall be laid along contour lines by hand, commencing at the lowest point of the area and working upward. The transverse joints of sod strips shall be staggered and the sod carefully placed to reduce tight joints. The sod shall be firmed, watered, and re-firmed immediately after it is placed. The "firming" shall be accomplished by application of a roller

weighing not less than sixty (60) nor more than ninety (90) pounds per linear foot of roller. On steep slopes, the sod may be firmed by compacting with hand shovels. The firming process shall pack the sod roots firmly into the prepared soil.

The contractor shall water installed sod within twenty-four hours and shall water all sod twice daily for a minimum of twenty-one (21) days from initial laying, except on those days where a minimum of 1/4 inch (1/4") of rain falls in a twenty-four hour period.

- 7208 PREPARATION OF THE SEEDBED. The area to be seeded shall be thoroughly tilled to a depth of at least three inches (3") by discing, harrowing or other approved methods until the soil is well pulverized. After completion of the tilling operation, the surface shall be cleared of all stones, stumps, or other objects larger than 1-1/2 inches (1-1/2") in thickness or diameter, and of roots, wire, grade stakes, and other objects that might be a hindrance to maintenance operations. Areas tilled shall then be brought to the desired line and grade and maintained until seeding and mulching is complete to ensure a smooth area with no gullies or depressions.

Any objectionable undulations or irregularities in the surface resulting from tillage or other operations shall be removed before planting operations are begun. Seedbed preparation shall be performed only during periods when satisfactory results are likely to be obtained. When results are not satisfactory because of drought, excessive moisture or other causes, the work shall be stopped until such conditions have been corrected to the satisfaction of the engineer.

- 7209 PLACEMENT OF SEED. Seeding may be accomplished by means of approved mechanical power-drawn drills followed by packer wheels, or by broadcast-type seeders or hydraulic type seeders in small areas not accessible to machine methods, or as approved by the city engineer. Mechanical power-drawn drills shall have depth bands set to maintain a planting depth of at least one-quarter inch (1/4") but not to exceed one-half inch (1/2"). All seed sown by broadcast-type seeders shall be "raked in" or otherwise covered with soil to a depth of at least one-quarter inch and rolled to obtain a firm seed bed. Water shall be applied when necessary.

Hydraulic seeding equipment shall include a pump capable of being operated at 100 gallons per minute and at 100 pounds per square inch pressure, unless otherwise directed. The equipment shall have an acceptable gauge and a nozzle adaptable to hydraulic seeding requirements. Storage tanks shall have a means of agitation and a means of estimation of the volume used, or remaining in the tank.

Seed shall not be drilled or sown during windy weather or when the ground is frozen or otherwise untillable. When a seed drill is used, it shall be set to space the rows not more than 4 inches (4") apart.

- 7210 MULCHING. Straw or hay mulch shall be applied uniformly to seeded areas at the rate of not less than two (2) tons per acre. Baled straw or hay shall be broken up and loosened sufficiently before being fed into the blower hopper to avoid the placing of matted or unbroken clumps. The use of wet straw or hay is prohibited.

Mulching shall be performed within twenty-four (24) hours after seeding, but not be done during windy or rainy weather or when such weather is imminent. Mulching shall be started at

the windward side of relatively flat areas, or at the upper part of steep slopes and shall continue uniformly until each area is covered.

The mulching material shall be disced or punched into the soil so that it is partially covered. Several passes may be required, if a straight disc is used, in order to mix the mulching material with the topsoil sufficiently to ensure protection from erosion by either wind or water. The mulch tilling operation shall be performed parallel to the ground contours.

- 7211 MAINTENANCE. All seeded areas shall be protected against damage by vehicle and pedestrian traffic by the use of barriers and appropriate warning signs. If at any time before completion and acceptance of the seeding work any portion of the seeded area becomes gullied or otherwise damaged, such damaged areas shall be repaired by filling with soil to original grade, re-seeding and re-mulching. All costs of repair work shall be borne by the contractor.

Contractor shall be responsible for watering areas seeded for a period of five (5) weeks after the time of seeding, except when thoroughly wetted by rain. Sprinkling of the seeded areas shall be carefully done in such manner as to avoid standing water, surface wash, or scour.

All sodded areas shall be thoroughly watered twice daily for a period of twenty days (20) after placing, except when thoroughly wetted by rain of 1/4-inch (1/4") or more in a 24-hour period.

- 7212 GUARANTEE. The contractor will be required to guarantee all sod installed on this project for twenty-one (21) days from the date of installation. After the twenty-one day period, the city will inspect all sod. Any sod that is dead at the end of the twenty-one day period shall be replaced by the contractor at his expense and is subject to an additional twenty-one day warranty period. All healthy sod at the end of the twenty-one day period will be accepted by the city and turned over to the property owner for maintenance. If the sod is accepted by the city, the contractor shall notify the property owners in writing that the city has accepted the sod and the property owner is now responsible for all sod maintenance and watering. The contractor is not required to guarantee any healthy sod accepted by the city after the twenty-one day period.

## SECTION 7300 - EROSION CONTROL

7301 **SCOPE** This section covers all labor and materials for the construction of erosion control measures. It includes the installation of erosion control devices that result in the reduction of soils leaving the construction site. Measures shall address but are not limited to inlet protection, stream protection, adjacent property protection, and public right-of-way protection.

7302 **GENERAL** Erosion control measures will be required on all construction plans submitted to the city of Gardner Public Works department. All projects which disturb a cumulative area of more than one acre will be temporarily seeded and mulched to the requirements of section "7200 Seeding and Sodding" immediately after street construction is complete. No other work will be allowed to begin until the seeding and mulching is complete unless approved by the City Engineer.

Erosion control measures will be required to be installed prior to any grading or construction activities. Erosion control methods include, but are not limited to, the following techniques: settling basins, sediment traps, rock entrance construction and perimeter controls. The contractor shall be responsible for the removal and clean-up of any sediment that is not retained on the construction site. All costs shall be the responsibility of the contractor.

During construction the City Engineer or his representative may require or the applicant may request, that the construction of the erosion control facilities and associated designs be modified. Modifications to the erosion control plan shall be submitted to City Engineer prior to any construction activities if physical conditions are discovered on the site inconsistent with the assumptions upon which the approval was based, including, but not limited to, unexpected soil conditions, runoff patterns, general weather generated problems, or changes in the design of the improved areas. All costs of the modifications will be considered subsidiary to erosion control.

7303 **MATERIALS** Materials shall consist of silt fence as shown in detail 73-1, straw bales as shown in detail 73-2, inlet protection as shown in detail 73-3, rock construction entrance as shown on detail 73-4, OR any combination of methods as approved by the city engineer or his representative.

Temporary seeding will be a combination of annual and perennial Rye. Total seeding rate will be 200 lbs/Acre and shall consist of 130 lbs/Acre of annual Rye and 70 lbs/Acre of perennial Rye. All seeding shall meet the requirements set forth in section 7200 SEEDING AND SODDING.

7304 **MAINTENANCE** On any property where grading or other work has been permitted, it shall be up to the permittee or owner to maintain and repair erosion control facilities. Whenever the City Engineer or his representative find that any existing grading, drainage, or ground condition is defective or deficient under the requirements of this division, all work shall cease until measures have been taken to meet the conditions of this division.

## SECTION 8000 - MATERIALS TESTING

- 8001 SCOPE. This section shall apply to all required testing services for soils, asphalt and concrete.
- 8002 GENERAL. All materials testing shall be conducted by a testing laboratory qualified and approved by the city to perform the required sampling, analysis, testing and report writing services. Reports shall be prepared by or under the supervision of and bear the seal and signature of a professional engineer licensed in the state of Kansas. Improperly completed or certified reports will not be accepted.
- 8003 RESPONSIBILITIES OF THE CONTRACTOR OR DEVELOPER. The contractor or developer shall provide all the required tests as herein specified at his expense. The contractor shall allow the testing agency access to the job site as may be required and shall furnish any labor as may be required by the testing agency to obtain and handle samples at the source of the material and at the site of the work. Adequate facilities shall be provided at the project site for the safe storage and proper curing of specimens requiring such facilities. The use of a testing agency's service does not relieve the contractor of the responsibility to furnish the required materials and to perform the required construction in full compliance with the city of Gardner technical specifications. The successful passing of a test does not constitute acceptance of the work or materials represented by the test or any portion of the work or materials. Final acceptance of the project shall be granted only through the issuance of a Project Completion Certificate by the city of Gardner and the expiration of the two (2) year maintenance period as established in these specifications.
- 8004 RESPONSIBILITIES OF THE TESTING AGENCY. All testing agencies shall meet the requirements of ASTM E329. A representative shall inspect, sample and test the materials and work as required by the city engineer. Any material furnished or work performed by the contractor failing to conform to the specification requirements shall be immediately brought to the attention of the city engineer and the contractor. Preliminary written field reports of all tests and inspection results shall be given to the contractor immediately after they are performed. A copy of all reports shall be forwarded to the city engineer as they are made available. Results of all tests taken, including failing tests, shall be reported. The testing agency and its representative are not authorized to revoke, alter, relax, enlarge or release any requirement of the specifications, nor to approve or accept any portion of the work.
- 8005 ASPHALT TESTING. Sampling and testing of the asphalt mix shall be required on all asphalt paving projects constructed in the city of Gardner.

Samples of the actual asphalt mix being used on a paving project shall be acquired by a qualified testing laboratory technician at either the construction site or the batching plant per ASTM Standards D979 and D3665. These samples shall be used to perform an aggregate gradation test (ASTM C136), asphalt extraction test (ASTM D2172), stability and flow test (ASTM D1559) and bulk specific gravity test (ASTM D2726). One complete group of tests shall be conducted on both the base material and the surface material for each paving project.

In-place density tests shall be conducted with a nuclear testing device during the course of the work. Density tests shall be performed by the testing laboratory to verify that the performance specifications in Section 1309 *Density and Surface Requirements* of this specifications manual have been achieved. The number of tests to be taken and the locations thereof shall be determined by the inspector based upon his observation of the paving process. A minimum of two (2) tests per 1500 feet of street improvement shall be taken unless otherwise directed by the city engineer. Tests performed with a nuclear device shall be conducted as per the requirements of ASTM D2950.

8006 CONCRETE TESTING. Sampling and testing shall be required on all concrete work including curb and gutter, sidewalk, slope paving, retaining walls, inlets, manholes or any other structures.

During the progress of the work, compression tests of the concrete used shall be made as directed by the engineer in accordance with the requirements of ASTM C31, C143, and C172. At least one sample, consisting of four (4) cylinders minimum, shall be taken from each 100 cubic yards of concrete placed or fraction thereof. In the event that the total amount of concrete on a project does not exceed 200 cubic yards, a minimum of four (4) specimens (consisting of four (4) cylinders each) shall be submitted for the project. In the case of a reinforced concrete box, a minimum of one sample shall be taken for each day's pour. The cylinders shall be cast in the field and transported to the laboratory 24 hours after the concrete was placed. Each set of compression test cylinders shall be marked or tagged with the date and time of day the cylinders were made, the location in the work where the concrete represented by the cylinders taken was placed, the delivery truck or batch number, the air content, and the slump. From each sample consisting of four cylinders, one (1) shall be broken at seven (7) days, one (1) at fourteen (14) days and two (2) at twenty-eight (28) days noting the compressive strength of each break.

Slump tests (ASTM C143) and air tests (ASTM C231) shall be made for each 25 cubic yards of concrete placed or fraction thereof. A minimum of two (2) slump and air tests shall be taken per day. Slump and air tests shall be taken with each cylinder series.

If samples of fresh concrete have not been obtained and tested, a minimum of three (3) cores shall be taken per ASTM C42 and broken as directed by the engineer. Air content (ASTM D457) and cement content (ASTM C85) shall also be determined. Concrete in the portion of the structure from which the core was taken will be considered adequate if the average strength of the cores is equal to a minimum of 95% of the specified strength (f'c) and if the strength of any single core is not less than 80% of f'c. All core holes shall be completely filled with a low-slump, high strength concrete at the expense of the contractor.

All reports by testing laboratories shall include the type of structure and information on obtaining, transporting, storing, curing, time between obtaining and casting cylinders (when applicable), supplier, finisher and batch as well as the specific test data.

8007 SOIL TESTING. Sampling and testing shall be required on all subgrade preparation for street construction and all trench backfilling operations within the city of Gardner.

Prior to the contractor commencing subgrade compaction for any street improvement project, the city engineer shall designate the locations and depths at which a qualified technician shall acquire samples of soil for performing a moisture density test (ASTM D698 for cohesive soils and ASTM D2049 for non-cohesive soils). A minimum of one (1) density test and maximum of two (2) density tests shall be performed for every 1000 feet of street construction.

Reports for moisture-density tests shall include the date, the location of the tests, the elevation or depth at which the test was taken, the maximum dry density, and the optimum moisture content as well as properly constructed moisture-density curves for each sample. Also included shall be a determination of the soils plastic index (PI) and liquid limit and classification in accordance with ASTM D2487.

During the progress of the subgrade preparation, in-place density tests shall be performed with a nuclear density tester by a qualified technician approved by the city of Gardner. The number of tests to be taken and the location thereof shall be determined by the inspector based upon his observation of the subgrade preparation. A minimum of two (2) tests per lift per 1500 feet of street improvement shall be taken unless otherwise directed by the city engineer. Results of these tests shall indicate whether or not the performance specifications stated in Section 1205 *Compaction Requirements* of this specification manual have been achieved. If the tests indicate the compaction is not sufficient, the contractor shall increase the compactive effort on all such inadequately compacted areas. Tests performed with a nuclear device shall be conducted as per the requirements of ASTM D2922.

During the progress of the work of trench backfilling, in-place density tests shall be performed with a nuclear density tester by a qualified technician. The number of tests to be taken and the locations thereof shall be determined by the inspector based upon his observation of the backfilling process. A minimum of two (2) tests per 1000 feet of trench shall be taken unless otherwise directed by the city engineer. Results of these tests shall indicate whether or not the performance specifications stated in Section 6018 *Trench Backfill* of this specification manual have been achieved. If the tests indicate the compaction is not sufficient, the contractor shall increase the compactive effort on all such inadequately compacted areas.